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ABSTRACT

Mission to Planet Earth (MTPE) is an integrated, sustainable environmental education program that focuses on the concept of Earth system science which integrates fields like meteorology, oceanography, atmospheric science, geology, and biology. The program has the following objectives: training the next generation of scientists to use an interdisciplinary approach, continuing to educate educators as research evolves and capabilities change, raising the awareness of policymakers and citizens to enable informed decision making, improving science and math literacy, and improving the linkage between scientists and educators. This publication provides information about agency-wide MTPE education resources and programs conducted at pre-college through postdoctoral levels. The catalog is divided into the following sections: Introduction, Student Programs, Teacher Enhancement and Curriculum Support, Educational Technology, and Resources. The Resources section contains listings of MTPE education materials and general National Aeronautics and Space Administration (NASA) resources, including Internet sources, for teachers and students. (JRH)

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1995 Catalog of Education Programs and Resources

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Understanding Our Changing Planet

NASA's Mission to Planet Earth

1995 Catalog of Education Programs and Resources

Office of Mission to Planet Earth
Office of Human Resources and Education
National Aeronautics and Space Administration

Washington, DC
May 1995



Reply to Attn of:

YM

JUN 16 1995

Dear Colleague:

In 1993, NASA's Office of Mission to Planet Earth and the Office of Human Resources and Education published the first catalog of NASA Mission to Planet Earth education programs and resources. Since that time our activities in this area have grown considerably. We are developing an integrated, sustainable environmental education program across the nation. The programs and products listed in this publication represent a baseline that our offices are committed to building upon to foster a public awareness through the formal education system.

Mission to Planet Earth is NASA's contribution to developing a vastly-improved understanding of the Earth. The unique vantage point of space provides information about the Earth's air, land, water, and life-and their interactions-not available using any other means.

While the main goal of Mission to Planet Earth is scientific understanding, the ultimate product of the program is education, in its broadest form. The concept of Earth system science, which integrates fields like meteorology, oceanography, atmospheric science, geology, and biology, is still fairly new to the scientific community, and is beginning to reach educators and the general public.

To effectively and efficiently contribute to Earth system science education, the program is focusing on the following objectives: train the next generation of scientists to use an interdisciplinary approach; continue to educate educators as research evolves and capabilities change; raise awareness of policymakers and citizens to enable informed decision making; improve science and math literacy; and improve the linkage between scientists and educators.

Through innovative education programs that provide a space-based perspective of our home planet to teachers and students at all levels, we invite you to join NASA in its Mission to Planet Earth.

Sincerely,

Charles Kennel

Charles F. Kennel
Associate Administrator for
Mission to Planet Earth

Spence M. Armstrong

Spence M. Armstrong
Associate Administrator for
Human Resources and Education

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Introduction

Since its beginning, the Earth has experienced environmental change. Although these changes are not always apparent, change in our environment is certain and continuous.

- ♦ Change can occur as quickly as the jolt of an earthquake or as slowly as the shifting of the Earth's crust;
- ♦ Change can be visible and awesome as a tornado or as slow and imperceptible as a molecule of deep ocean water moving toward the equator;
- ♦ Some of these changes are necessary for life, such as evaporation and precipitation of water, but some changes are detrimental to the well-being of this planet and the life on it, such as pollution of our air and water and thinning of the Earth's protective ozone shield;
- ♦ Change that occurs in one part of the Earth system affects other parts, such as the ejection of particles and gases into the atmosphere when a volcano erupts;
- ♦ Inevitably, environmental changes affect all our lives. Some touch us regularly, like the weather. Other changes are more infrequent but profound, like hurricanes, earthquakes, and tornadoes. More subtle changes -- such as those resulting from our use of land and water -- may take years to appear.

While environmental change is certain, there is uncertainty regarding how human activities are impacting these changes. We have altered the Earth by reconfiguring the landscape, by changing the composition of the global atmosphere, and by stressing the biosphere in countless ways. However, we do not fully understand either the short-term effects of our activities or their long-term implications. Nor do we understand enough about how the Earth works to know how any of these changes will affect us or predict when they might do so. Many important scientific questions remain unanswered.

NASA's Mission to Planet Earth

In the last three decades, we have changed the way we think about our planet. Apollo astronauts observed the Earth as a blue marble against a vast background of darkness - beautiful, but finite and changing. Our missions to other planets have revealed them to be fascinating and diverse, but also sterile. We know of no place like Earth.

NASA has developed a program, called Mission to Planet Earth (MTPE), that captures our spirit of space exploration and focuses it back on our own planet. Only from space can we obtain the global perspective needed to better understand how all parts of the Earth's environment - air, water, land, and life -

◆ Introduction

interact to make life possible. Data and analyses from MTPE, which includes extensive cooperation and contribution from other Federal agencies and other nations, are revealing some of the Earth's secrets. But the most revealing - and useful - discoveries are yet to come.

By using satellites and other tools to study the Earth, we hope to expand our understanding of how natural processes affect us and how we might be affecting them. Such studies will yield improved weather forecasts, tools for managing agriculture and forests, information for fisherman and coastal planners, and, eventually, an ability to predict how climate will change in the future.

Just as the first weather and communications satellites fundamentally changed our way of thinking about those fields, so will the elements of MTPE expand our perspective of the global environment and climate. Working together with the nations of the world, we are well on our way to improving our knowledge of the Earth and using that knowledge to the benefit of all humanity.

A variety of NASA satellites and instruments have provided important data for studying and understanding the global environment. For example, remotely-sensed data indicating ocean temperatures helps explain changes in polar ice, ocean vegetation, and global weather patterns. Global ozone measurements from space were the key to discovering the ozone hole. Studies of ocean "color" (photosynthetic activity) provide information about ocean vegetation, pollution, and changes in ocean chemistry.

The centerpiece of NASA's Mission to Planet Earth is the Earth Observing System (EOS), which is planned for launch beginning later this decade. EOS will consist of a series of satellites that will advance our knowledge of the physical, chemical, and biological phenomena that govern and integrate the Earth system. These include:

- ◆ hydrological processes that govern the interactions of land and ocean surfaces with the atmosphere through the transport of heat, mass, and momentum;
- ◆ biogeochemical processes that contribute to the formation, dissipation, and transport of trace gases and aerosols, and their global distribution;
- ◆ climatological processes that control the formation and dissipation of clouds and their interaction with solar radiation;
- ◆ ecological processes that are affected by, or will affect, global change, and their response to such changes through adaptation; and
- ◆ geophysical processes, that shape and modify the surface of the Earth through tectonics, volcanism, and the melting of glaciers and sea ice.

MTPE Discoveries and Noted Firsts

Some of the most significant advances in the Earth and environmental sciences have been the result of research conducted under NASA's MTPE. These advances have not only improved scientific understanding of our environment, but also produced practical applications for an improved quality of life. Some of MTPE's major discoveries and noted firsts include:

Weather

NASA launched the first weather satellite (TIROS I) in 1960, beginning a successful series of spacecraft that revolutionized weather prediction and improved hurricane-tracking techniques and severe storm warnings, thus protecting lives and properties around the world. NASA continues to build all of America's civilian weather satellites.

Land Surface

NASA pioneered studying the Earth's surface from space, spawning a growing commercial sector. NASA analyses of data from Landsat first proved that satellites could be used to accurately estimate tropical deforestation. These analyses revealed that the extent of deforestation in Brazil, while significant, was less than expected. NASA-funded researchers are also using Landsat data to track the deterioration of wetlands in the Chesapeake Bay and fight diseases threatening the \$10 billion California wine industry.

Earthquakes

Two NASA/Italian satellites have helped scientists precisely track movements of Earth's surface for nearly 20 years, increasing our understanding of earthquakes. NASA researchers also developed low-cost ground receivers that enable precise determination of land motion, another key in understanding seismic activity.

Oceans

NASA ocean research provided the first precise measurements of ocean height and most precise data on ocean circulation to date. A NASA/French satellite helped determine the strength and duration of the 1994/95 El Niño, the latest episode of the climate shift that can bring devastating rains to the U.S. and drought to other parts of the world. In the future, these data will help us precisely predict how El Niño will affect different regions of the world. From 1978-86, a NASA instrument provided the first global measurements of plant life productivity in the world's oceans -- an important step to understanding how climate may be changing and where fish are gathering; this data set will resume in 1995.

◆ Introduction

Ozone

A NASA satellite instrument confirmed the existence of the Antarctic ozone hole in 1985 and has monitored its growth since then. Data from NASA aircraft, balloons, satellites, and ground research helped confirm the link between human-produced chemicals and ozone destruction. This research contributed significantly to the international treaties signed to protect the ozone layer. Now NASA and National Oceanic and Atmospheric Administration (NOAA) measurements indicate that the treaties are beginning to work.

Education--MTPE's Ultimate Product

Beyond the scientific motivation for MTPE there are also compelling social reasons for exploring Earth from space. One of the four program goals, as cited in NASA's MTPE Strategic Plan, is to "foster the development of an informed and environmentally-aware public." Within this context, contributions by MTPE to the advancement of formal education are a major aspect of how the program's success will be measured.

Inherent to NASA's MTPE is the challenge of preparing today's students—who will be tomorrow's Earth system scientists, technologists, decision-makers, and informed citizens. NASA is committed to meeting this challenge through efforts that strengthen:

- ◆ Education at the professional level to prepare the next generation of Earth scientists to study Earth as a system.
- ◆ Education at the K-12 level to attract and retain participation of future generations in Earth sciences; and, to develop the approach and tools that will enable teachers to take an Earth system science approach.
- ◆ Relationships between scientists and educators to effectively communicate scientific results.
- ◆ Education of the public to build confidence and understanding in scientific methods and results.
- ◆ Partnerships and other mechanisms to leverage the development of MTPE education materials and products and increase their availability; and, to encourage the development of external expertise capable of translating MTPE research into useable information for education at all levels.

MTPE supports a variety of education activities developed in partnership with the NASA Headquarters Education Division and carried out through its Field Centers. These activities include student enrichment and research opportunities; teacher enhancement and curriculum support efforts, including

programs targeted to build institutional capabilities; and the development of educational publications and other materials. As technology enables more hands-on, interactive learning, a priority will be increased use of technology in pre-college activities. Our education activities strive to foster a solid foundation in the traditional sciences (e.g., physics, biology, and chemistry) and mathematics, as well as encouraging an interdisciplinary, system approach to studying the Earth sciences.

Computer technology, such as the Internet, is providing powerful tools that enable NASA to connect with teachers across the country. There are numerous sites on the Internet where MTPE information is available to teachers and students at all grade levels. These sites contain a wealth of data, imagery, and information from NASA's MTPE and related education activities and resources. New to this year's catalog is a section devoted to Internet sources of MTPE data and information.

In addition to computer network sources of satellite information, NASA also produces a wide variety of print and non-print materials for teachers. NASA lithographs, teachers' guides, posters, videotapes, laserdisc, CD-ROMs, and slide sets all make MTPE information available to teachers across the country.

NASA's Mission to Planet Earth: 1995 Catalog of Education Programs and Resources, provides information about Agencywide MTPE education resources and programs conducted at pre-college through postdoctoral levels. This catalog is not intended to represent all of NASA's education programs; instead, it focuses on NASA education efforts most relevant to MTPE.

Student Programs

MTPE provides opportunities for students to develop new skills, gain experience working with researchers, and to learn first-hand about Earth science careers and research.

Student enrichment activities include brief courses, summer workshops, and other relatively short-term education experiences, which expose students to Earth science subjects and processes. Opportunities are available for elementary, secondary, undergraduate, and graduate students, as well as for postdoctorates. Student enrichment opportunities are generally offered during the summer months. These workshops and NASA Center experiences may last up to twelve weeks. Applications are typically due in early spring, with selections announced by late spring or early summer.

Student research opportunities provide direct financial assistance to students (e.g., fellowships) at graduate and postdoctorate levels coupled with Earth science research experiences (e.g., research and teaching assistantships, stipends to participate in research). These programs also serve to facilitate the transition of students into the workplace and are administered annually. Announcements are made throughout the year. Proposals are generally due in the spring, selections are made during the spring and summer, and fellowships typically begin during the fall.

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See also:

- ◆ Ground Truth Studies Program, 45

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Ames Aerospace Encounter

Objective:

To provide an interactive computer tutorial designed to teach about science, mathematics, and technology.

Description:

Ames Research Center hosts fourth, fifth, and six grade classes in an interactive, hands-on program, entitled the Ames Aerospace Encounter. Located in a renovated supersonic wind tunnel, the Aerospace Encounter involves students in activities focused around four topics: aeronautics, space science, living and working in space, and Earth system science. Students experiment with a table-top wind tunnel, examine planetary probes, and simulate a mission aboard a space station.

The Earth system science tutorial features color, sound, animation, and images of Earth taken from aircraft and satellites. Using a mouse to point and click buttons on the computer screen, students learn about remote sensing, light, color, and geography. Using remotely-sensed images, the students attempt to find their way to Moffett Field, California by clicking on specific geographic features, and identifying North America, California, the San Francisco Bay area, and finally the runway on Moffett Field at NASA Ames Research Center. This strategy helps students learn to recognize geographic features across many scales and become familiar with remote-sensing techniques.

Participants/Eligibility:

This popular one-day experience is designed for class-sized groups, fourth-sixth grades, and should be scheduled well in advance.

Deadlines and Additional Information:

Mr. Tom Clausen
NASA Ames Research Center
Mail Stop 204-12
Moffett Field, California 94035-1000
Phone: (415) 604-4989
World Wide Web: <http://ccf.arc.nasa.gov/dx/encounte.html>

◆ Student Programs

Challenger Center for Space Science Education: Encounter Earth

Objective:

Using space exploration as a theme, the Challenger Center for Space Science Education was founded to create positive student experiences, excite students about the impact of technology on their future, and inspire students to pursue math, science, and technology studies.

Description:

Challenger Learning Center sites are an international network of high-technology spaceflight simulators for hands-on learning experiences, using a variety of mathematics, science, and problem-solving skills. Annually, thousands of students visit Challenger Learning Center sites located across the U.S. and in Canada. Learning Centers conduct on-site missions, provide teacher in-service training, and supply pre- and post-visit curriculum kits.

Through funding from the National Science Foundation and technical support from NASA, the Challenger Center for Space Science Education has developed *Encounter Earth*. Students learn how to study the Earth's environment from an orbiting satellite in order to obtain a global perspective of the Earth as an interrelated system.

As part of the scenario, each student in the class becomes a crew member on one of eight teams of the elite ERS-1 Emergency Response Squad in the Challenger Learning Center. Each team participates in both the Mission Control Operations area and the Space Lab; all team members have assigned roles with given responsibilities. The mission focuses on the following cooperative student teams working together to complete their mission.

◆ SATELLITE

Mission Control determines the correct frequencies for Earth probes, satellites, and Earth laboratories to use. Space Lab builds and deploys a new Low Earth Orbiting satellite to replace the non-functioning satellite.

◆ COMMUNICATION

Mission Control communicates messages and information from Mission Control Personnel to their Space Lab partners. Space Lab communicates messages and information from Space Lab personnel to their Mission Control partners.

◆ DATA ACQUISITION AND EXAMINATION

Mission Control receives data from the Space Lab and compares it to historical Earth data. Space lab receives data from Mission Control and compares it to historical Earth data.

◆ ECOSPHERE

Compares population densities with observed night city light density in North America to determine if there is a correlation.

◆ HYDROSPHERE

Concludes whether ocean temperatures and currents are directly related to ocean vegetation.

◆ BIOSPHERE

Determines whether vegetation is directly related to ground moisture and temperature.

Student Programs ♦

♦ **ATMOSPHERE**

Determines whether rainfall and temperature are directly related to cloud cover.

♦ **GEOSPHERE**

Determines whether ocean temperature and currents are directly related to sea level.

Participants/Eligibility:

Encounter Earth is designed for 5-8th grade students and their teachers.

Deadlines and Additional Information:

For information about the nearest Challenger Learning Center, contact:

Challenger Center for Space Science Education
1055 North Fairfax Street
Suite 100
Alexandria, Virginia 22314
Phone: 1-800-98-STARS

◆ Student Programs

Global Learning and Observations to Benefit the Environment (GLOBE)

Objective:

To join students, educators, and scientists from around the world in studying the global environment.

Description:

GLOBE consists of a worldwide network of K-12 students who work under the guidance of GLOBE-trained teachers to make environmental observations at or near their schools, report their data to a GLOBE processing facility, receive and use global images created from their data, and study environmental topics in their classrooms. GLOBE environmental measurements are in the following study areas: Atmosphere/Climate; Hydrology/Water Chemistry; and Biology/Geology. The data acquired by students will be used worldwide by environmental scientists in their research to improve our understanding of the global environment.

GLOBE is managed by an interagency team that includes NASA, the National Oceanic and Atmospheric Administration (NOAA), the National Science Foundation, the Environmental Protection Agency, and the Departments of Education and State. NOAA is the lead agency for GLOBE.

Participants/Eligibility:

Currently, over 1,900 K-12 U.S. schools have registered to become GLOBE schools. A school can become a GLOBE school by meeting the following basic requirements, and by agreeing to:

- ◆ have its students acquire environmental data using scientific measurement instruments at their school;
- ◆ have its students transmit these data to a GLOBE processing center as often as required for each measurement;
- ◆ have its students study the global environmental images that will be generated based on GLOBE data taken by students around the world;
- ◆ have its students participate in GLOBE guided by one or more teachers trained through the GLOBE Program, who will use GLOBE-provided educational materials;
- ◆ send at least one teacher to a GLOBE-provided 3-day training workshop at a location in the school's general part of the country;
- ◆ have the necessary GLOBE scientific measurement instruments for use by students; and
- ◆ have a suitable school computer configuration, to be available for use at least 20% of each school day to support participation in GLOBE, i.e., to be used for data entry and transmission to a GLOBE processing center and for viewing of global environmental images and related information generated by a GLOBE processing center.

Deadlines and Additional Information:

Schools that meet the basic requirements are invited to complete GLOBE registration materials, which are available from the GLOBE office or at the World Wide Web site identified below.

GLOBE Program
744 Jackson Place
Washington, DC 20503
Phone: (202) 395-6500
E-mail: info@globe.gov
World Wide Web: <http://www.globe.gov>

NASA Contact:
Ms. Lisa Ostendorf
NASA Headquarters
Code YP
Washington, DC 20546

The JASON Project

Objective:

To bring the thrill of exploration and discovery live to students around the world, while motivating and training their teachers, as they participate in an electronic field trip.

Description:

Dr. Robert D. Ballard founded the JASON Project in 1989, after receiving thousands of letters from children wanting to know how he discovered the *RMS Titanic*. Each spring, a two-week scientific expedition is mounted in a remote part of the world and broadcast in real-time, using state of the art technology, to a network of educational, research, and cultural institutions.

JASON programs are broadcast to over 26 Primary Interactive Network Sites (PINS) in 16 states, England, Canada, and Bermuda. Several NASA Centers are PINS. Through the PINS, the JASON Project provides teacher training and a curriculum specially-developed to highlight the science, technology, engineering, and social studies of that year's expedition. Participating teachers and students at the interactive downlink sites have the ability through telepresence to "go live" to the expedition, to operate the scientific equipment being used, and to talk directly with the scientists at the expedition site.

From April 15-27, 1996, the JASON VII voyage will investigate life at the edge of a moving ocean where scientists, students, and teachers will explore conditions for life and the relationships which exist there. The topography of southern Florida today -- the Everglades, Florida Bay, Florida Keys, and relic reefs -- provides a cross-sectional view of different, interconnected, shallow water habitats. These habitats provide essential food and nutrients for humans as well as the other living organisms throughout the cross-section, thus any disturbances quickly affect the system.

Here scientists, students, and teachers will explore this unique area using the Navy's NR-1 submarine to map the relic reefs; investigate life underwater through investigations on coral reef growth and the cycle of nutrients; and conduct experiments with sharks to determine their feeding and sensory perception.

Past JASON voyages have included an expedition to Hawaii, the world's most isolated spot of land where fantastic adaptation of pioneering species has created a unique biological laboratory (February 27-March 11, 1995); a journey to the rainforests, caverns, Mayan ruins, and coral reef of Belize (February 28-March 12, 1994); diving to the hydrothermal vents in the Sea of Cortez and learning about the gray whales of San Ignacio Lagoon (March 1993); following the footsteps of Charles Darwin to explore the unique land and marine life of the Galapagos islands on the equator (December 1991); to Lake Ontario for a comprehensive examination of two warships from the War of 1912 (May 1990); and an expedition to the Mediterranean Sea to explore an ancient Roman shipwreck (May 1989)

Participants/Eligibility:

Teachers and students of grades 4-10 participate in the JASON Project at PINS located across the country. These sites host thousands of students annually who view the live JASON expeditions. The PINS also provide teachers with in-service sessions using the JASON curriculum to prepare their students for the annual expedition.

◆ Student Programs

Deadlines and Additional Information:

The JASON Project is administered by the non-profit JASON Foundation for Education. For more information, please contact:

JASON Foundation for Education
395 Totten Pond Road
Waltham, Massachusetts 02154
Phone: (617) 487-9995; FAX: (617) 487-9999
E-mail: info@jason.org
World Wide Web: http://seawifs.gsfc.nasa.gov/JASON/HTML/JASON_HOME.html

Several NASA Centers are part of the JASON PIN'S network, providing teacher training, curriculum materials, and are interactive downlink sites for the annual JASON Program. Contact the following NASA Center representatives for detailed information about their programs and plans:

Mr. Tom Clausen
Ames Research Center
Mail Stop 204-12
Moffett Field, California 94035-1000
Phone: (415) 604-5544

Ms. Jan Ruff
Goddard Space Flight Center
Code 130
Greenbelt, Maryland 20771
Phone: (301) 286-6255

Dr. Robert Fitzmaurice
Johnson Space Center
Mail Code AP-2
2101 NASA Road 1
Houston, Texas 77058
Phone: (713) 483-1257

KidSat

Objective:

To excite K-12 students about space and Earth exploration and applications by allowing them to apply the principles of physics, mathematics, and other sciences in a real space mission experience.

Description:

In this pilot project, participating students will design and operate Earth-observing flight instruments which will be placed on observatories including the Space Shuttle, the Mir Space Station, and eventually the International Space Station.

The participating organizations in this project are NASA Jet Propulsion Laboratory (JPL), the California Space Institute (CalSpace) at the University of California--San Diego, and The Johns Hopkins University Institute for the Academic Advancement of Youth (IAAY). JPL is responsible for project management, flight instrument implementation, and, initially, the data system; CalSpace for mission operations; and IAAY for curriculum development, teacher training, and evaluation.

Students will determine basic science and mission requirements, and develop instrument, mission, and data system designs. Interactive, integrated supplementary curriculum modules, including software to access both the mission operations and the data systems, will be made available for classroom use. A student mission control center will be established in each pilot district. Students from around the country (and the world) will have access to the KidSat data in real time and post-mission.

Participants/Eligibility:

The pilot project will include two Shuttle flights over a period of three years, and involve middle school students and teachers from Pasadena, California; San Diego, California; Charleston, South Carolina; Omaha, Nebraska; Houston, Texas; and Baltimore, Maryland.

Deadlines and Additional Information:

For more information, contact:

Dr. JoBea Way
Jet Propulsion Laboratory
MS 300-233
4800 Oak Grove Drive
Pasadena, CA 91109
E-mail: way@lor.jpl.nasa.gov

◆ Student Programs

Project SUN (Students Understanding Nature)

Objective:

To develop and supply middle and high school student teams with SUN kits, enabling them to collect and provide NASA Jet Propulsion Laboratory (JPL) with daily, time-resolved insolation and ultraviolet radiation (UV) data on a continuing basis.

Description:

The SUN kit includes low-cost, scientifically-accurate sensors; computer interfaces; associated data conditioning, expansion, and communications software; an operations manual; and curriculum materials.

Participating schools supply two Apple IIe or IIC computers that are converted to dedicated data loggers for the project. In addition, participating schools must commit to supply NASA/JPL with at least two days per week of data for an entire school year to obtain the SUN kit and JPL support. This support not only includes hardware, software, and documentation, but also in-service training for teachers, student mentoring, station inspection and certification, and recognition of the school as part of the NASA/JPL Student Solar Radiation Monitoring Global Network (SSRN). JPL will condition the data from all participating data sites and present it in a graphical form on the JPL Public Information BBS, allowing access to the data directly or via the Internet.

The project is unique in that it has equal scientific and educational goals. The scientific data that will be produced must be of sufficient quality that other researchers in the field can use it. At the same time, the educational aspects of the project must motivate students to such a degree that they seek to learn about science, mathematics, and technology to enable them to be professional contributors to the knowledge base of humanity.

The National Renewable Laboratories (NREL) has agreed to review the Project SUN visual data for scientific value and then include it in their database. The Biospherical Company of San Diego (operator of the UV monitoring site at the South Pole for the National Science Foundation) has agreed to review the UV radiation data collected by Project SUN schools.

Participants/Eligibility:

Project SUN is a pilot effort working with schools in southern California; Detroit, Michigan; and Winsor, Ontario, Canada. The International Space Summer School in Sydney, Australia will include Project SUN as part of its curriculum during the July 1995 session; schools in Brisbane and Perth will also join the network during July. Applications have been received from schools in Florida and New York to join the Project SUN network later in 1995. Current funding will allow the pilot project to include approximately 25 to 30 schools. Future plans are to establish university partnerships and seek additional funds to allow a major expansion of the project during 1996.

Deadlines and Additional Information:

Dr. Gilbert Yanow
NASA Jet Propulsion Laboratory
Mail Stop CS/530
4800 Oak Grove Drive
Pasadena, CA 91109
Phone: (818) 354-8060 or 354-6916; FAX: (818) 354-8080
E-mail: Gilbert.Yanow@jpl.nasa.gov

Space Science Student Involvement Program (SSIP)

Objective:

To address the need for greater literacy in the areas of science, critical and creative thinking, mathematics, and technology.

Description:

Since 1980, NASA and the National Science Teachers Association (NSTA) have co-sponsored an annual SSIP student competition. The five competitions that comprise SSIP are designed to foster greater scientific literacy among elementary, middle, and high school students, especially in the areas of aerospace science and technology. Thousands of teachers throughout the United States successfully use SSIP to support curricular goals, spark student interest, encourage creative thinking across disciplines, and involve students in science process skills. The competition includes the following categories:

- ♦ Mission to Planet Earth (MTPE)
- ♦ Interplanetary Art
- ♦ Future Aircraft/Spacecraft Design
- ♦ Mars Science Expedition
- ♦ Aerospace Internships

Student teams competing in the MTPE category investigate the effect of human activity on the Earth's ecosystem, then develop a plan for an interdisciplinary program, using satellites to address one of the planet's environmental dilemmas. The student teams are required to design a mission plan, which addresses topics such as:

- A) Analysis of Problem -- Which human activities are most likely to cause global change? Given limited funds, which factors affecting the Earth's ecosystem should be studied first?
- B) Experimental Design -- What problem(s) or factor(s) affecting the Earth's ecosystem will be investigated? What is the hypothesis? What data are needed?
- C) Plan for the Future -- How can we reduce the impact of human activity? How do we get the population to agree to the change? How do we avoid economic and social problems?

Winning student teams and their teachers are recognized at the SSIP National Symposium, in Washington, DC, where students present their projects. In addition, winning students in the MTPE category receive a Space Camp scholarship.

Participants/Eligibility:

The MTPE competition is open to teams of students in grades 6-8. Each student design team must consist of three or four students. All entries must be accompanied by a completed entry form.

Deadlines and Additional Information

Entries are due annually by January 10; the SSIP National Symposium is held each May in Washington, DC. To request an official entry form and more information, please contact:

Ms. Linda Heller
National Science Teachers Association
Attention: SSIP Competition
1840 Wilson Boulevard
Arlington, Virginia 22201-3000

NASA Contact:
Mr. Larry Bilbrough
NASA Headquarters
Code FEE
Washington, DC 20546

Undergraduate

- ◆ NASA Academy at Goddard Space Flight Center (GSFC), 23
- ◆ Summer Fellowships in Ocean Remote Sensing, 24
- ◆ Summer Institute on Atmospheric and Hydrospheric Sciences, 25

NASA Academy at Goddard Space Flight Center (GSFC)

Objective:

To provide participating students with 1) a working knowledge of some of NASA's programs, how Field Centers operate, and the link to the private sector; 2) a technical experience in a world-class laboratory; and 3) a fraternal teaming experience to show how people work together.

Description:

The NASA Academy consists of a ten-week session involving twenty-four students who are placed in the laboratories of Goddard Space Flight Center's (GSFC) most innovative scientists or engineers. Participating students are selected from across the country, through their local NASA Space Grant Consortium colleges and universities.

Three days a week, students assemble in plenary sessions and deal with a unique subject. These sessions are a give-and-take dialogue between experts and the students. Subjects range from spacecraft design to the latest findings from Mission to Planet Earth and the Hubble Space Telescope. Sessions also include discussions of policy issues, such as finance and proposal evaluation, and off-site visits to contractors, NASA Headquarters, Goddard Institute for Space Studies, the Wallops Island launch site, Langley Research Center, and a trip to Kennedy Space Center to view a Space Shuttle launch. The program philosophy is to provide students with learning experiences that they cannot get through traditional college classes.

Participants/Eligibility:

Students are initially nominated by their local NASA Space Grant Consortium, with up to twenty-four students selected each year by GSFC University Programs. Eligibility requirements include:

- ♦ a demonstrated interest in the space program;
- ♦ enrollment (as of June 1 of the program year) as a junior, senior, or graduate student;
- ♦ a minimum B average;
- ♦ a major in science (physics, chemistry, biology, etc.), mathematics, engineering, computer science, or other area of interest to the space program; and
- ♦ citizenship or permanent residence (as of June 1 of the program year).

Deadlines and Additional Information:

Program announcement, application, and selection is generally completed by March 1. The program is co-sponsored by GSFC and the NASA Space Grant College and Fellowship Program. State Space Grant Consortia provide a stipend for the ten-week period and round-trip transportation to and from GSFC; GSFC provides local transportation mileage reimbursement, food, and local housing. To apply, first contact the lead office of the NASA Space Grant College and Fellowship Program in your state (see page 94).

Dr. Gerald Soffen
Code 160
Goddard Space Flight Center
Greenbelt, Maryland 20771
Phone: (301) 286-9690
E-mail: GSFCacademy@ccmail.gsfc.nasa.gov
FTP: university.gsfc.nasa.gov
World Wide Web: <http://university.gsfc.nasa.gov/SA/academy.html>

◆ Student Programs

Summer Fellowships in Ocean Remote Sensing

Objective:

To stimulate promising students to continue their studies with advanced research that uses remote-sensing techniques to study estuarine, coastal, and oceanic processes.

Description:

This program provides undergraduates and beginning graduate students with twelve-week summer fellowships to work with leading scientists at NASA Goddard Space Flight Center (GSFC) and the University of Maryland, College Park using remote sensing to study estuarine, coastal, and oceanic processes. Participants:

- ◆ acquire a background in the application of remote-sensing methods to problems in oceanography;
- ◆ develop an understanding of existing satellite and aircraft systems used in studying marine systems and of the data processing methods involved;
- ◆ use remote sensing to address research problems in conjunction with ongoing studies of NASA/GSFC and University of Maryland scientists;
- ◆ learn how to interpret, organize, and present the results of a scientific research project; and
- ◆ contribute to the publication of scientific data by serving as interns participating in research projects and co-authors on manuscripts.

During the summer program, students participate as members of teams, which include other students, technicians, and scientists. A brief orientation includes introductory lectures. Following the orientation period, each student is paired with an individual scientist and pursues a study of mutual interest and agreement. The general topics that are included in each summer's program are advertised in brochures and application materials.

Participants/Eligibility:

Advanced undergraduates and beginning graduate students are eligible to participate. Students are recruited nationally and six-eight students are selected annually. Participating students are provided a stipend, housing, and travel support.

Deadlines and Additional Information:

The general schedule is:

Announcement Released	Late January
Deadline for Application	Early April
Selection Announcement	Late April
Session Begins	June

To request application materials and additional information, contact:

Dr. Lawrence W. Harding, Jr.	NASA Contact:
Maryland Sea Grant College	Dr. Robert Frouin
0112 Skinner Hall	NASA Headquarters
University of Maryland	Code YS
College Park, MD 20742	Washington, DC 20546

Summer Institute on Atmospheric and Hydrospheric Sciences

Objective:

To introduce undergraduate students majoring in all areas of the physical sciences to graduate research opportunities in the atmospheric and hydrospheric sciences, both theoretical and experimental.

Description:

NASA's Goddard Space Flight Center (GSFC) convenes an annual summer institute for undergraduate students, which focuses on atmospheric and hydrospheric sciences. The first part of the program is a one-week lecture series, covering the basic areas of atmospheric and hydrospheric sciences and is given primarily by GSFC scientists. The lecture series is followed by nine weeks of research with a GSFC scientist as a mentor. During the research period, cooperating university professors lecture on the work that is being conducted at their institutions.

Participants/Eligibility:

The program is directed at undergraduates, majoring in one of the physical sciences, who are in their junior year at the time of application. However, all undergraduates are eligible to apply. No previous experience in atmospheric or hydrospheric sciences is needed.

Deadlines and Additional Information:

There is no formal application form for this project. Applications should be submitted in the form of a letter containing the following information: (1) full name; (2) address and phone number at school; (3) permanent address and phone number at which you can always be reached; (4) current grade level; (5) current grade point average; (6) major field; (7) Social Security Number; (8) one-page typewritten statement of your professional goals and interests; (9) description of computer programming and laboratory experience, if any; (10) citizenship; (11) transcripts of any courses and grades; (12) the names of two faculty members who know your work well and have been asked to provide letter of reference. The transcripts and letters of reference should be sent directly by the university and faculty members to the address below.

The deadline for receipt of 1995 applications was February 11, with awards announced March 31. All applications receive consideration, without regard to race, color, age, national or ethnic origin, or sex. For additional information, contact:

Dr. Per Gloersen
NASA Goddard Space Flight Center
Code 971
Greenbelt, MD 20771
E-mail: per.gloersen@gsfc.nasa.gov

Graduate and Postdoctorate

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- ◆ National Research Council (NRC) Resident Research Associateships (RRA), 34
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See also

- ◆ NASA Academy at Goddard Space Flight Center (GSFC), 23.

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Courses in the Operation of Multi-Disciplinary Oceanographic Time Series Stations

Objective:

To train international oceanographers to initiate and conduct oceanic time-series research stations.

Description:

Through NASA funding, the Bermuda Biological Station for Research, Inc. (BBSR) is developing and offering courses for professional oceanographers in the operation of multi-disciplinary, time-series research stations. Data collected from long-term, time-series studies are needed to understand and model the interactions of the Earth system and to assess the impacts of human activities on the Earth's environment. Currently, only a few oceanic time-series research programs exist; the BBSR course is intended to increase the number of programs.

The BBSR offers three courses each year, beginning in 1993/1994, over an initial three-year period. Professional oceanographers are selected in groups of two-three from nations with a commitment to the development of oceanographic time-series studies. Selection and recruitment takes place in coordination with NASA; the courses are conducted at the BBSR. Students also participate in a BBSR-administered Bermuda Atlantic Time Series (BATS) field trip to the Sargasso Sea, to gain hands-on experience using at-sea data collection techniques. Each course lasts twelve days: three days spent on lectures and discussions dealing with scientific concepts and program overview and management, five days to participate in a BATS cruise, and four days for hands-on or informal demonstrations and lectures on analytical protocols and follow-up lectures on data processing and quality-control issues.

Participants/Eligibility:

The course is targeted for professional oceanographers, scientists who have a Ph.D. or equivalent experience in oceanography, or advanced graduate students. Preference is given to applicants from countries that are currently in the process of initiating time-series research programs, either independently or in the context of the Joint Global Ocean Flux Study (JGOFS). Participants receive travel and housing support.

Deadlines and Additional Information:

For additional information, contact:

Dr. Dennis Hansell
Bermuda Biological Station for Research, Inc.
17 Biological Lane
Ferry Reach, GE-01
Bermuda

NASA Contact:
Dr. Robert Frouin
NASA Headquarters
Code YS
Washington, DC 20546

◆ Student Programs

Graduate Fellowships in Global Change Research

Objective:

To train the next generation of Earth scientists and engineers to be capable of effectively using and managing the data and information generated by the Earth Observing System (EOS), in support of NASA's Global Change Research Program.

Description:

Participating graduate students conduct research in the areas of:

- ◆ climate and hydrologic systems (including tropical precipitation),
- ◆ ecological systems and dynamics,
- ◆ biogeochemical dynamics,
- ◆ solid Earth processes,
- ◆ human interactions,
- ◆ solar influences, and
- ◆ data and information systems.

Atmospheric chemistry and physics, ocean biology and physics, ecosystem dynamics, hydrology, cryospheric processes, geology, and geophysics are acceptable areas of research, provided that the specific research topic is relevant to NASA's global change research efforts, including the Earth Observing System (EOS), the Tropical Rainfall Measurement Mission (TRMM), and NASA's Mission to Planet Earth program.

Awards are made for an initial one-year period, but may be renewed annually, usually no more than two times, based on satisfactory progress as reflected in both academic performance and evaluation by the faculty advisor. The amount of award for 1995/96 is \$20,000, which may be used as a stipend to defray living expenses, tuition, travel, books, supplies, and fees. An additional amount of \$2,000 is available by request for the faculty advisor's use in support of the student's research. Over 250 fellowships have been awarded since the program began in 1990. Up to 50 new fellowships will be awarded each year, subject to availability of funds.

Participants/Eligibility:

Students admitted or enrolled in a full-time Ph.D. program at accredited U.S. universities are eligible to apply. Students may enter the program at any time during their graduate work. They may also apply in their senior year, prior to receiving their baccalaureate degree, but must be admitted and enrolled in a Ph.D. program at a U.S. university at the time of award. Individuals receiving this award may not concurrently receive other Federal fellowships, internships, or employment. U.S. citizens and resident aliens will be given preference; however, non-U.S. citizens pursuing graduate degrees in the U.S. may also apply. No applicant will be denied consideration or appointment on the grounds of race, creed, color, national origin, age, or sex.

Deadlines and Additional Information:

In a national competition, participants are selected based on their submitted research proposal and their academic credentials. Proposals are selected by NASA Headquarters on a competitive

basis. Criteria for selection include:

- A) academic excellence as based on transcripts and a letter of reference by the student's academic advisor;
- B) the quality of the proposed research, for students already in graduate school; and
- C) the relevance of the proposed research to the NASA's role in the U.S. Global Change Research Program (Mission to Planet Earth).

Selection panels include representation from the academic community, NASA's Office of Mission to Planet Earth and Education Division, and professional societies in the Earth sciences. Program deadlines are:

Receipt of application packages	March 15 for the following academic year
Selection announcements	July 15
Anticipated start dates	September 1

For additional information, contact:

Dr. Ghassem Asrar
Code YS
NASA Headquarters
Washington, DC 20546

◆ Student Programs

Graduate Student Researchers Program (GSRP)

Objective:

To reach a culturally-diverse group of promising U.S. graduate students whose research interests are compatible with NASA's program in space science and aerospace technology.

Description:

Fellowships of up to \$22,000 are awarded for one year and are renewable, based upon satisfactory progress, for up to a total of three years. These fellowships are awarded in areas related to NASA's program in space science and aeronautics, including research related to NASA's Mission to Planet Earth.

In addition to NASA Headquarters, each of the NASA Field Centers also support students under the GSRP. Fellows supported by NASA Centers must spend some period of time in residence at the center, taking advantage of the unique research facilities of the installation and working with Center personnel.

Participants/Eligibility:

Eligibility for the program is limited to full-time (as defined by the college or university) graduate students from an accredited U.S. college or university. Applicants must be U.S. citizens. Students may enter the program at any time during their graduate work or may apply prior to receiving their baccalaureate degree. All applications must be sponsored by the student's graduate department chair or faculty advisor.

Deadlines and Additional Information:

Each year NASA selects approximately 100 new awardees based upon competitive evaluation of their academic qualifications; their proposed research plan, or plan of study; and their planned utilization of NASA research facilities. Approximately 50 of the new awards are for research in the areas of Earth and space sciences.

Proposals for these fellowships are due February 1 each year. Applicants should submit the original and nine copies of all proposal materials to the appropriate NASA facility (NASA Headquarters or Field Center). NASA Field Center proposals should be addressed to the attention of the Program Administrator listed in the GSRP application information. Copies of the GSRP application information can be obtained by contacting the University Affairs Officer at any NASA Field Center (see page 88), or by contacting:

Graduate Student Researchers Program
Code FEH
NASA Headquarters
Washington, DC 20546

Graduate Student Summer Program (GSSP) in the Earth System Sciences

Objective:

To increase student interest in pursuing interdisciplinary studies within the Earth sciences and provide an opportunity to pursue a research project at Goddard Space Flight Center (GSFC).

Description:

GSFC's Earth Sciences Directorate, in conjunction with the Universities Space Research Association (USRA), sponsors a ten-week Graduate Student Summer Program in the Earth System Sciences. Participating students work on an intensive research project at GSFC for the majority of the program period. Each student is given significant latitude to choose from a pool of research projects and mentors. Project topics are developed and implemented in conjunction with scientists from the three Earth science laboratories at GSFC: The Laboratory for Atmospheres, the Laboratory for Terrestrial Physics, and the Laboratory for Hydrospheric Processes. During the project period, all participating students are invited to lunch-time sessions with a variety of GSFC researchers. Students are expected to produce oral and written reports on their summer research activities. The written reports are intended to be shared with members of the global change research community and subsequent program participants.

Participants/Eligibility:

The program is open to all students enrolled in, or accepted to, an accredited graduate program in the physical or biological processes, mathematics, computer science, or engineering. In addition, the first five days of the summer program are dedicated to an intensive public lecture series, which is open to the general public on a space-available basis. This series is designed to provide a comprehensive introduction to the science and techniques of remote-sensing and satellite observations. At the 1995 session, well-known experts from GSFC and the university research community presented lectures on the remote-sensing, atmospheric, oceanographic, biological, and societal impact aspects of the El Niño Southern Oscillation (ENSO) phenomenon.

Students are selected on the basis of academic record; proven motivation and qualification to pursue interdisciplinary or multidisciplinary research related to Earth sciences; clarity and relevance of research interests to NASA programs; and letters of recommendation.

Deadlines and Additional Information:

Applications for the 1995 GSSP were due February 13, 1995 for the Graduate Student Summer Program planned for June 12 - August 18, 1995. The registration deadline for the public lecture series is typically in early June. For additional information, contact:

Ms. Paula Webber
USRA/GSSP
7501 Forbes Boulevard
Suite 206
Seabrook, Maryland 20706
Phone: (301) 805-8396
FAX: (301) 805-8466
E-mail: paula@gvsp.usra.edu

◆ Student Programs

Jet Propulsion Laboratory Postdoctoral/Postgraduate Associate Program

Objective:

To provide significant and unique training and professional growth opportunities for the nation's future scientific and technological leaders.

Description:

The program is under the cognizance of NASA Jet Propulsion Laboratory's (JPL) Chief Scientist, and is administered by the JPL Educational Affairs Office. Participants are engaged in research, in residence at JPL, under the guidance of research advisors who are senior, full-time staff members. All areas of research at the Laboratory are included; fields relevant to MTPE are heavily represented. Appointments are for one year, but may be extended for one or two additional years upon mutual agreement. Appointees receive an annual stipend and participate in all employee benefit plans. Between thirty and forty individuals are involved in the program at any given time.

Participants/Eligibility:

Postdoctoral Associates are recent Ph.D. recipients from universities in the United States or abroad. Postgraduate Associates are graduate students currently enrolled in an accredited university; they may be either Master's or Ph.D. candidates, but must have completed all course work required for their degrees. Appointees are normally U.S. citizens or permanent resident aliens; appointments of others must conform to NASA/JPL foreign national employment practices.

Deadlines and Additional Information:

Applications are accepted year-round. For more information, contact:

University Affairs Office
Jet Propulsion Laboratory
MS 183-900
4800 Oak Grove Drive
Pasadena, CA 91109
Phone: (818) 354-8251

NASA-NOAA Summer School for the Earth Sciences: Processes of Global Change

Objective:

To provide an educational opportunity, for Ph.D. students and recent Ph.D. graduates, on topics related to current research in global change.

Description:

This five-day lecture series is sponsored by NASA and NOAA and organized jointly by the Earth and Space Sciences Division of the Jet Propulsion Laboratory - California Institute of Technology and the California Space Institute - University of California at San Diego. Course content consists of lectures by leading global change researchers on topics including: An Overview of Global Change Processes, Biogeochemical Cycles, Hydrologic Cycle, Atmospheric Chemistry, Atmospheric Physics, Ocean-Atmosphere Interactions, Social Implications of Climate Change, Modeling of Climate Change, and The Role and Response of Ecosystems.

Participants:

The course is directed to Ph.D. students and recent Ph.D. graduates (within five years). Up to 250 students can be accommodated for the program. There is no registration fee. Partial support for travel and lodging is available for a limited number of students. Support is available only to students living in the United States; civil servants are not eligible for financial support.

Deadlines and Additional Information:

The deadline for applying for the 1995 course was April 28; all applicants will be notified by mail after May 19. The 1995 course will be held July 17-21 at the California Institute of Technology.

For more information, contact:

Ms. Marguerite Schier
Jet Propulsion Laboratory
MS 183-335
4800 Oak Grove Drive
Pasadena, CA 91109
E-mail: mlss@scn1.jpl.nasa.gov
FAX: (818) 393-6546

◆ Student Programs

National Research Council (NRC) Resident Research Associateships (RRA) Program

Objective:

To provide postdoctoral scientists and engineers of unusual promise and ability opportunities for research on problems, largely of their own choice, that are compatible with the interests of the sponsoring laboratories, and to contribute thereby to the overall efforts of the Federal Laboratories.

Description:

The NRC, through its Associateship Program Office, conducts a national competition to recommend and make awards to outstanding scientists and engineers at recent postdoctoral and experienced senior levels for tenure as guest researchers at participating laboratories. Recent postdoctoral graduates are provided with an opportunity for concentrated research in association with selected members of the permanent professional laboratory staff, often as a climax to formal career preparation. Recently-established scientists and engineers are afforded an opportunity for research without the interruptions and distractions of permanent career positions. The RRA program is administered by the National Research Council under a contract monitored by NASA's Education Division, Higher Education Branch.

Participants:

This program is open to all Ph.D.s, or equivalent, in science and engineering disciplines relevant to NASA research programs. As many as 250 associateships are on tenure annually. Foreign nationals are eligible for this program.

Deadlines and Additional Information:

Each applicant must submit a research proposal that responds to a specific research opportunity at the desired NASA Field Center. These research opportunities are published annually in separate brochures for each NASA Field Center. Awardees must hold a Ph.D., Sc.D., or other earned research doctoral degree recognized in U.S. academic circles as equivalent to the Ph.D., or must submit acceptable evidence of completion of all formal academic requirements for one of these degrees before tenure may begin. Applications, submitted directly to the NRC, are accepted on a continuous basis. The following is the general schedule for this program:

Applications postmarked by:	Will be reviewed in:
April 15	June
August 15	October
January 15	February

Research opportunity brochures, containing detailed information on application procedures, are available upon request by contacting the NASA University Affairs Officer at any NASA Field Center (see page 88), or by contacting:

National Research Council
Associateship Program - TJ 2094
2101 Constitution Avenue, NW
Washington, DC 20418
FAX: (202) 334-2759

Ms. Elaine Schwartz
Code FEH
NASA Headquarters
Washington, DC 20546

Summer School for High Performance Computational Sciences (SSHPCS)

Objective:

To promote computational science education through the NASA Center for Computational Sciences (NCCS) at NASA Goddard Space Flight Center and the Universities Space Research Association (USRA).

Description:

This three-week program is designed for graduate students pursuing doctoral degrees in the physical sciences with an interest in massively-parallel computing. The NCCS generally provides comprehensive research in GSFC's space and Earth science programs. On the basis of application, sixteen graduate students are selected each summer to participate in this intensive computational physics lecture series. During the program, the students are divided into four teams to facilitate hands-on computer training and small group interaction.

Participants:

This program is open to U.S. university graduate students involved in disciplines related to the space and Earth sciences. Students should have passed their Ph.D. qualifying exams.

Deadlines and Additional Information:

Application selection is performed by a committee that evaluates candidates on the basis of demonstrated scholastic excellence, qualifications, and interests relative to space and Earth science, plus experience and/or interest in computational physics. Applications should include a curriculum vitae (or resume') with a publication list, a description of relevant experience, an academic transcript showing two full years of work, and two letters of reference. Applications should be submitted prior to May 1 to the following person:

Mr. David Holdridge
USRA
NASA Goddard Space Flight Center
Code 610.3
Greenbelt, MD 20771

NASA Contact:
Dr. James Fischer
Goddard Space Flight Center
Code 935
Greenbelt, Maryland 20771

Teacher Enhancement and Curriculum Support

Teacher Enhancement and Curriculum Support ♦

Elementary and secondary teacher enhancement and curriculum development activities cover grades K-12 and include continuing education activities and in-service programs that update skills, as well as enrich and strengthen the theoretical and practical basis for classroom and laboratory instruction. Activities include workshops, special experiences for teachers, and activities that encourage the use of Earth observations from space to illustrate or supplement existing course content and curriculum related to science, mathematics, and technology concepts. Teacher workshops are generally held during the summer. The schedule and duration of activities may vary from year to year, ranging from one day to several weeks.

College and university faculty enhancement opportunities are available to work at NASA Centers, in order to enrich their scientific and technical expertise and to establish NASA research contacts. These opportunities are held in the summer and last up to eleven weeks. Curriculum development efforts are focused on developing interdisciplinary Earth system science curriculum for undergraduate students.

Elementary and Secondary

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- ◆ Global Change Workshop For Teachers, 43
- ◆ Goddard Space Flight Center Teacher Intern Program, 44
- ◆ Ground Truth Studies Program, 45
- ◆ Maryland Initiative, 46

See Also:

- ◆ GLOBE, 16
- ◆ The JASON Project, 17

Earth System Science Community (ESSC)

Objectives:

Provide on-going collaboration, professional development, and problem-solving in order to:

- ♦ enable students and teachers to investigate the Earth system;
- ♦ develop a collective understanding of the Earth system;
- ♦ enable students to learn process thinking, scientific method, collaborative problem-solving, model-building and scientific communication; and
- ♦ develop an Earth system science curriculum and support system over the Internet.

Description:

The ESSC was established in 1994 by high school and university educators devoted to studying the Earth system. The Earth System Science Community Curriculum (ESSCC) Project builds upon a successful pilot Earth system science course developed at Gonzaga College High School, Washington, DC during 1993.

The community's instructional method is based upon students working in teams on eight to ten research projects per year using techniques and resources of several science disciplines, including: chemistry, biology, physics, Earth science, and computer science. Students conduct investigations in teams, relying on collaboration and peer education. The teams are guided by a process of investigation which organizes classroom activities. Team activities include background research, hypothesis formulation, research planning, qualitative and quantitative modeling, data sourcing, data visualization, and scientific communication, which consists of three steps: oral presentations and peer review, editing, and publishing scientific findings on the World Wide Web (WWW). Students use remote-sensing data from several sources in a variety of formats acquired primarily over the Internet. Students derive their own information products from remote-sensing data through visualization, manipulation, editing and layout using programs such as Excel and NCSA Collage; apply the information to their quantitative models (STELLA II); and create hypermedia scientific reports published on the WWW by integrating their information products, models, and texts.

Topics of student investigation follow the *Science Strategy for the Earth Observing System* (Asrar and Dozier, 1994):

- **Modeling the Earth System:** Physical Climate System, Hydrologic Cycle, and Biogeochemical Cycles
- **Energy Budget:** Clouds, Radiation, Water Vapor, and Precipitation
- **Oceans:** Circulation, Productivity, and Air-Sea Exchange
- **Troposphere:** Greenhouse Gases and Tropospheric Chemistry
- **Land Surface:** Ecosystems and Hydrology
- **Stratosphere:** Ozone and Stratospheric Chemistry
- **Cryosphere:** Ice Sheets, Polar and Alpine Glaciers, and Seasonal Snow
- **Volcanoes and Climate Change**

Participants/Eligibility:

New faculty meet each summer for a two-week summer immersion workshop, which prepares them to teach a full-year, interdisciplinary, applied science course on the Earth system. High school or university faculty, from all science disciplines, are encouraged to apply.

◆ Teacher Enhancement and Curriculum Support

Currently, six high schools and two universities are participating in this three-year project: Pittsburg High School, Pittsburg, CA; Model Secondary School for the Deaf, Washington, DC; Robertson High School, Las Vegas, NM; Nerinx Hall, St. Louis, MO; and the host institution, Gonzaga College High School, Washington, DC. The sixth high school is Canadian: Burnaby South, Burnaby, British Columbia. The two universities participating in the program are Penn State University, Earth System Science Center and the U.S. Naval Academy, Department of Oceanography. Funding exists for four new high school teachers and two universities to join the program beginning in the summers of 1995 and 1996.

Deadlines and Additional Information:

Participants receive a stipend, room and board during the two-week summer program; participants' schools receive funding to assist in defraying the costs of releasing participating faculty from one course for the first year of their participation.

Applications forms are due in April and can be obtained by writing to the address below or completing a form on-line at the World Wide Web site identified below:

Mr. Michael Keeler or Dr. Farzad Mahootian
ECologic Corporation
5164 Fulton Street, NW
Washington, DC 20016
FAX: (202) 842-5088
E-mail: keeler@ecologic.net, farzad@ecologic.net
World Wide Web: <http://www.circles.org>

Global Change Workshop For Teachers

Objective:

To acquaint middle and high school teachers with current global change research and enable them to develop classroom applications.

Description:

This workshop is co-hosted by NASA Jet Propulsion Laboratory (JPL) and the California Space Institute at the University of California, San Diego. It is held concurrently with the *NASA/NOAA Summer School for the Earth Sciences: Processes of Global Change* (see page 33), and will utilize the same group of lecturers. Experts will discuss the Earth's atmosphere, oceans, land surface, living things, and how they are affected by human activity and intervention. These lectures will be followed by group seminars, led by master teachers, to discuss how the lecture topics can be applied to the school science curriculum. Emphasis will be placed on development of hands-on activities that can be implemented at the home school.

Participants/Eligibility:

Twenty middle school and twenty high school science teachers are chosen each year by an independent panel of judges convened by the National Science Teachers Association (NSTA). All middle and high school teachers are eligible to apply.

Deadlines and Additional Information:

Information brochures and applications are widely distributed by NSTA. Deadline for applications is normally mid-April.

There is no registration fee for this workshop. Travel expenses and lodging are provided for participating teachers living in the United States.

For more information, contact:

Ms. Marguerite Schier
Jet Propulsion Laboratory
MS 183-335
4800 Oak Grove Drive
Pasadena, CA 91109
E-mail: mlss@scn1.jpl.nasa.gov
FAX: (818) 393-6546

◆ Teacher Enhancement and Curriculum Support

Goddard Space Flight Center Teacher Intern Program

Objective:

To provide Maryland secondary school teachers with hands-on experiences of current science and technology that can be applied to classroom instruction.

Description:

Secondary school teachers are placed with scientists, mathematicians, computer technologists, and engineers for eight weeks each summer to participate in Goddard Space Flight Center's (GSFC) research and development activities. Participating teachers produce final reports and products for their activities. Oral presentations are made and products frequently include material that enhances existing county science curriculum from video animation to lab experiments. In some cases, teacher interns return during the school year to continue their individual research work with their science mentor.

This program is managed through a grant with the Prince George's County school system, which is the local school district where GSFC is located. The Prince George's County school system also elicits the participation of teachers from neighboring counties to compete along with local county educators for positions as interns at GSFC.

Participants/Eligibility:

The target audience for this program is Maryland secondary science teachers. Teachers must be willing to make a full eight week commitment to the program during the established dates for each summer. Applications are managed by the local Maryland school district's science coordinator.

Deadlines and Additional Information:

The Prince George's County school system distributes and collects applications from Maryland teachers. The county may conduct an initial screening of candidates. Applications are presented to GSFC mentors whose Directorates are financially sponsoring the interns. The designated mentors select the teachers, based on application, who best fit their research activities.

Applications are available no later than April with deadlines in late May. Approximately 10 teachers are selected for the summer internship; the majority are placed with GSFC's Earth science directorate.

For more information, please contact:

Ms. Jan Ruff
Goddard Space Flight Center
Code 130
Greenbelt, Maryland 20771
(301) 286-6255

Ground Truth Studies Program

Objective:

To increase student awareness of the process and benefits of basic science through an exploration of natural and human-induced environmental changes.

Description:

The Aspen Global Change Institute (AGCI) was founded in 1989 with the purpose of providing a forum for interdisciplinary exploration of, and education about, current issues in global environmental change. AGCI carries out a year-round outreach program with the objective of fostering a dialogue between the science, education, industry, and policy communities and to develop outreach programs and educational materials that support this objective.

A key accomplishment has been the development of a student Ground Truth Studies Program. The Ground Truth Studies program is an interdisciplinary, hands-on, K-12 education program. Ground truth refers to ground-based, field observations or measurements that verify remotely-sensed data. The Ground Truth Studies Program required the development of curriculum materials, teacher training, and pilot testing of the concept in 1991, in twelve schools representing six states. Since that time, AGCI has conducted teacher workshops with organizations such as the University of Alabama in Huntsville (UAH), through UAH's Space Orientation for Professional Educator (SOPE) workshops, as well as independent workshops, for a total of over 1000 teachers from across the United States.

During 1995 and 1996 NASA funding will expand the Ground Truth Studies Program by allowing the training of more teachers and the development of new educational materials which include a second teacher handbook and instructional videos.

Participants/Eligibility:

K-12 teachers and students interested in global environmental change research and related issues.

Deadlines and Additional Information:

For additional information, contact:

Mr. John Katzenberger
Aspen Global Change Institute
100 East Francis Street
Aspen, Colorado 81611
WWW: <http://infosphere.com/clients/smallworks/agci>

NASA Contact:
Dr. Malcom Phelps
Code FET
NASA Headquarters
Washington, DC 20546

◆ Teacher Enhancement and Curriculum Support

Maryland Initiative

Objective:

To enhance classroom instruction in Earth and environmental science programs in the secondary schools of Maryland.

Description:

Goddard Space Flight Center (GSFC) manages the Maryland Initiative, an Earth and environmental science education effort, which consists of a number of elements. Participating teachers are called ambassadors, because they are expected to serve as ambassadors for Earth science teaching enhancement in their local school system. The ambassadors are engaged in a four-week, summer residential institute at GSFC and the University of Maryland. In addition to the summer institute, eight follow-up seminars are also held during the school year to bring computer skills up to date, address a unique Earth science topic, and to share achievements, as well as challenges and how to overcome them in the classroom. Each ambassador is assigned a GSFC scientist mentor for the summer institute and follow-on school year activities. Ambassadors receive up to six hours of graduate credit for successful completion of the summer institute and follow-up seminars.

Each ambassador will be able to:

- ◆ understand how the Earth system can be studied from space and how data gathered in this manner can be used to enhance earth and environmental science teaching;
- ◆ identify how to use computers and computer networks to enhance Earth and environmental science teaching. Specifically, CD ROM programs, liquid crystal displays and laser disk players. Each ambassador is equipped with hardware and software to serve as a model for their district;
- ◆ understand how to access and use available NASA resources to enhance Earth and environmental science teaching. Specifically, to use NASA Teacher Resource Centers and prepare teaching materials drawn from the centers;
- ◆ implement with students the Earth monitoring project designed at the institute and share data with other participants as part of a total state Earth monitoring project; and
- ◆ share teaching materials and strategies with other teachers through electronic means, seminars, and workshops.

The project is developing a catalog for educators on Earth science resources available on the internet, which will be available through the NASA Teacher Resource Center (TRC) Network (See page 81). The project is also developing a CD ROM on the geology and geography of Maryland for use in the classroom, which is planned to be available fall 1995.

Future plans for this project include providing a dedicated staff member in GSFC's Teacher Resource Lab to assist teachers in using electronic networking to access and share information. This staff member will provide a hot line for assistance, conduct workshops on the use of internet for teachers, and seek material for distribution to teachers on using the Internet in the classroom. A special workshop of state education leaders, advanced data processing experts, GSFC experts, and aerospace industry members is also planned in 1995/96 to share information on the topic of network interconnectivity.

Teacher Enhancement and Curriculum Support ♦

Participants/Eligibility:

Twenty-four Maryland Earth science teachers are selected annually to participate in this project. Each school district in the state is represented. Teachers are selected by a committee of school system administrators appointed by the Assistant Superintendent for Instruction in the Maryland State Department of Education.

Deadlines and Additional Information:

Participation is limited to Maryland educators who are nominated by their local school district, according to criteria such as:

- ♦ Is the individual an outstanding teacher, willing and able to easily adapt course content and teaching strategies to include new information and technologies?
- ♦ Is the applicant experienced in the use Macintosh computers?
- ♦ Is the applicant available and willing to participate in both the four week institute and eight seminars?

Each school system nominates three candidates that meet the selection criteria and submit their names to a statewide selection committee, which is responsible for final selection.

For more information, please contact:

Ms. Jan Ruff
Goddard Space Flight Center
Code 130
Greenbelt, Maryland 20771
Phone: (301) 286-6255

Undergraduate and Graduate

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NASA/University JOint VEnture (JOVE)

Objective

JOVE was started in 1989 to develop aerospace research capabilities and to promote science and engineering education through NASA/university partnerships.

Program Description

JOVE is a NASA-sponsored research program designed to build research capabilities at U.S. institutions of higher education that have had little or no involvement in the Nation's space program. In that regard, JOVE is a capability-building program, akin to the National Science Foundation's EPSCoR (see page 95). To qualify for participation in the JOVE program, a college or university must have less than \$100,000 of current research support from NASA. The university commitment to the joint venture includes granting release time for each of its JOVE Faculty Research Associates to conduct research during the academic year. A minimum of 25% full-time equivalent per faculty member must be obligated to the project to permit adequate research progress. The summer stipends of the faculty are shared, with 50% contributed by the institution and 50%, up to a maximum of \$6,000 per summer, contributed by NASA.

Participating universities are expected to use their JOVE research connection as a basis for curriculum development (i.e., the enhancement of student research potential) and outreach programs, which should be designed to serve students at that institution, K-12 students, as well as individuals and groups in the broader community served by the JOVE institution. NASA will make money available to support student participation in the JOVE research. The student support is shared equally by NASA and the university, up to an annual maximum of \$10,000 from NASA.

In return for university support of faculty time for research, and matching support for both student scholarships and faculty summer stipends, NASA selects faculty participants to become members of its varied research teams, makes data available, provides mentoring by a researcher at one of the nine NASA field centers or at a NASA-sponsored center of research, and facilitates the establishment of a computer network connection to the campus to electronically "link" the Faculty Research Associates to the NASA mission databases.

The JOVE experience begins in the summer with each of the Faculty Research Associates spending 10 weeks in residence at their respective research sites. This period of research is equivalent to the NASA Summer Faculty Fellowship Program experience (see page 51). The joint research, curriculum development, and outreach will begin in the fall time frame, after the Faculty Research Associates have returned to their home institutions. The commitment to the JOVE program by both NASA and the institution of higher education is for three years.

Participants

88 Academic Institutions in 46 states, including Puerto Rico; 178 Faculty Research Associates; and approximately 300 graduate and undergraduate students. The estimated number of 1995 summer faculty participants is 25.

◆ **Teaching Enhancement and Curriculum Support**

Deadlines and Additional Information

Candidate institutions are invited to send a representative to the JOVE Orientation Conference held each October. The general schedule for the JOVE program is:

Announcement:	October Orientation Conference
Proposals Due:	January 31, 1996
Selection:	Mid-March 1996
Begin Date:	June 1, 1996

Interested institutions should contact:

Dr. Frank Six, Mail Stop DS01
University Affairs Office
Marshall Space Flight Center
Huntsville, AL 35812

or

Mr. Maurice Estes, Jr.
4950 Corporate Drive
Suite 100
Huntsville, AL 35806
Phone: (205) 895-0582
E-mail: maury@space.hsv.usra.edu

Summer Faculty Fellowship Program

Objective:

To increase engineering and science faculty knowledge of NASA research and missions.

Description:

NASA's Education Division, Higher Education Branch, in cooperation with the American Society for Engineering Education (ASEE), awards summer fellowships to engineering and science educators. The Summer Faculty Fellowship Program is designed to further the professional knowledge of engineering and science faculty and NASA scientists and engineers, and contribute to ongoing research at NASA facilities. The program provides a good opportunity for faculty to establish contacts with NASA researchers and generally learn more about how to access the agency.

Those selected for participation receive a weekly stipend of \$1,000, plus travel expenses, and a relocation allowance. Fellows spend ten or eleven weeks working at a NASA Field Center on aeronautics or space-related research, including Mission to Planet Earth. Their working experience is supplemented with enrichment activities, such as short courses, workshops, and seminars.

Participants/Eligibility:

Approximately 300 fellows are selected annually. Participating faculty members must be U.S. citizens with teaching or research appointments in universities or colleges and have, preferably, two years experience. Interested persons are encouraged to obtain the program brochure for current research opportunities.

Deadlines and Additional Information:

Application deadline is January 15 with letters of appointment March 1. Interested persons are encouraged to obtain a program brochure for current research opportunities. Information may be obtained by contacting the University Affairs Officer at any NASA Field Center (see page 88) or by contacting:

American Society for Engineering Education (ASEE)
1818 N Street, NW
Suite 600
Washington, DC 20036
Phone: (202) 331-3500

◆ Teacher Enhancement and Curriculum Support

University-based Cooperative Program in Earth System Science Education (ESSE)

Objective:

To foster the establishment of a national academic program for Earth system and global change science, and expand the interdisciplinary interests of future scientists who elect to pursue Earth science research professionally.

Description:

The ESSE program consists of faculty from twenty-two U.S. universities who are linked with one another and with NASA scientists in the development of undergraduate curricula in Earth system science. Managed by the Universities Space Research Association (USRA), the program offers financial incentives to universities that are willing to participate cooperatively with other universities and NASA in interdisciplinary curricula development for Earth system science education.

Each university in the program has developed a survey course and senior-level courses in which faculty present Earth system issues as a socially-relevant, challenging, and important class of scientific problems. The objective of the survey-level course is to instill among the general student population an appreciation of the social, economic, and political implications of global change, and a scientific understanding of interrelationships between the Earth's physical and climate system and ecological systems. The objective of the advanced senior-level course is to provide students in the sciences and mathematics with an interdisciplinary perspective of Earth science and global change research. In the senior course, students from different academic departments work in teams to study and develop conceptual and computer models of physical, chemical, and biological processes of the Earth system. The senior course is taught by faculty from at least two relevant academic departments, and focuses on scientific issues that draw upon the strengths of the institution. As part of the broader program, universities participate in an organized exchange of scientists and faculty, in which visiting faculty and scientists from other participating universities and from NASA Centers bring to the classroom expertise and perspectives different from those at the host campus.

During the course of the program, participating faculty and NASA scientists meet twice annually to discuss their programs, plan for the faculty exchange, and explore broader issues and objectives such as strategies for developing degree programs in Earth system science and instructional materials.

Participants/Eligibility:

The following universities participate in the ESSE program:

<i>University</i>	<i>Faculty Coordinator</i>
University of Alabama-Huntsville	Stanley Kidder
University of Alaska-Fairbanks	Joshua Schimel
University of Arizona	Lisa Graumlich
University of California-Los Angeles	Richard Turco
University of California-Santa Barbara	Raymond Smith/ Catherine Gautier
University of Florida	David Hodell
University of Iowa	Jerald Schnoor/Frank Weirich
Johns Hopkins University	George Fisher

Teacher Enhancement and Curriculum Support ♦

University

University of Minnesota
University of New Hampshire
New York University
Northwestern University

Ohio State University
Pennsylvania State University
Princeton University
Purdue University
Rice University
Utah State University
University of Wisconsin-Madison
Rutgers University
Stanford University

Washington University

Faculty Coordinator

Kerry Kelts
Robert Harriss
Michael Rampino
Abraham Lehrman/
John Walther
Ellen Thompson
Eric Barron/Jon Nese
George Philander
Ernest Agee
Arthur Few
James Evans
Francis Bretherton
James Miller
Gary Ernst/
Jonathan Roughgarden
Raymond Arvidson

Deadlines and Additional Information:

Based on the success of the current program, the ESSE program will involve a new set of universities starting in the 1995-96 academic year. A new Call for Proposals was issued to four-year U.S. colleges and universities on June 1, 1995; proposals were due July 15, 1995

A key initiative in the extended ESSE program will be the continued development of an Internet-based Earth System Science and Global Change curriculum, maintained on the USRA/ESSE World Wide Web server. This server will provide for a structured electronic repository for the Earth System Science and Global Change curriculum and materials produced through the collaborative efforts of the ESSE participants.

For more information contact:

Dr. Donald Johnson (608) 262-2538. donj@ssec.wisc.edu
or Dr. Michael Kalb (301) 805-8396 mkalb@gvsp.usra.edu
or Mr. Martin Ruzek (414) 732-4514 ruzek@usra.edu
Universities Space Research Association
7501 Forbes Blvd, Suite 206
Seabrook, MD 20706
World Wide Web: <http://www.usra.edu/esse/ESSE.html>

NASA Contacts:

Ms. Lisa Ostendorf
Code Y
NASA Headquarters
Washington, DC 20546

Dr. Nahid Khazenie
Code 170
Goddard Space Flight Center
Greenbelt, Maryland 20771

Educational Technology

Educational Technology

- ♦ NASA Classroom of the Future, 58
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See Also:

- ♦ Ames Aerospace Encounter, 13
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- ♦ Resources, 76-77, 89-92, 97-105

Some of the most exciting advances in MTPE education are based upon making resources available through technologies, such as the Internet, CD-ROM, and computer software. The growing availability of technology in the classroom has helped to make up-to-the minute, complex information and data available to classrooms worldwide. Through innovative education programs, based on cutting-edge technology NASA is on the forefront of electronically reaching out to schools around the globe.

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◆ Educational Technology

NASA Classroom of the Future

Objective

Enhance the learning and teaching process for mathematics, science, and technology education using advanced computer and telecommunications technologies.

Description

The Classroom of the Future (COTF) Program, which began at Wheeling Jesuit College in 1990, was established by NASA to serve as its premier national research and development center for educational technologies, as well as a key Agency resource in providing technology-based tools and resources to K-12 schools. The specific goals of the program today are to:

- ◆ develop interactive multimedia products focused on mathematics, science, and technology education using aerospace-related discoveries, sciences, and technology to enhance learning for K-12 students;
- ◆ provide a controlled environment in which to test software prior to testing in schools;
- ◆ provide a model environment in which to conduct teacher training and education on uses of advanced computer and telecommunications technology to enhance the learning process; and
- ◆ provide dissemination of information, multimedia applications, curricular resources, research findings, and teaching methods via computer and video local and wide area networks.

Established by federal legislation in 1990, the mission of the NASA COTF is to help improve the quality of science, mathematics, and technology education in the United States. The COTF develops exemplary multimedia curriculum materials, conducts applied research into teaching and learning with technology-based materials, offers model preservice and inservice teacher education programs, and conducts high-quality educational activities for students.

COTF facilities include a software and multimedia development center, the "21st Century Learning Center," a NASA Regional Teacher Resource Center, a Challenger Learning Center, a Cooperative Learning Classroom, satellite/distance education facilities, video production facilities, experimentation physics and chemistry laboratory, and a Discovery Center for interactive multimedia displays and hands-on science and mathematics activities. Most of these specialized areas within the facility are used in teacher education programs.

Math and Science K-12 Products:

Astronomy Village -- During the summer of 1995, the COTF will release its first major multimedia product, the "Astronomy Village," a CD-ROM-based interactive multimedia program that places high school freshmen in the role of astronomers. Working in cooperative settings, teams of students address one of ten problem-based scenarios. For example, the students may investigate stellar phenomenon that suggest the presence of a supernova. Assessment is largely based on student products such as reports and presentations. The "Astronomy Village" has been well-received in demonstrations and is an excellent example of the design, development and implementation abilities of the COTF.

BioBLAST -- A new COTF project, Biology: Better Learning Through Adventure, Simulation, and Telecommunication (BioBLAST), will create, test, disseminate, and assess a technology-rich high school biology curriculum supplement. Student higher-order thinking and creativity are project goals. The project will engage students in powerful learning experiences in which they become immersed in a deep and narrow "slice" of biology curriculum while also gaining a broad perspective from their team interactions. Students will have on-going dialogs within research teams, across teams, and via networking technologies with the NASA research community. The BioBLAST project will be developed, tested, and implemented during the next two years.

Exploring the Environment -- A new project funded under the NASA Public Use of Remote-Sensing Data (RSD) Program (see page 63). The project will develop computer software modules for use by high school students and teachers investigating Earth-science questions via extended inquiries over the Internet.

Since 1990, making use of existing Wheeling Jesuit College campus and school district facilities, the COTF staff has offered science and mathematics workshops to almost 1,000 teachers and over 10,000 students. Topics covered in workshops and classes have included "Forces of Flight," "Newton in Space," "Integrating Space into the Math/Science Curriculum," and "Heat and Energy." Summer institutes at COTF have included one- and two-week sessions focused on incorporating the National Council of Teachers of Mathematics (NCTM) standards into the mathematics curriculum and on incorporating astronomy, weather (via remote sensing), and aviation into the K-12 mathematics and science curriculum.

Additional Information:

For more information, contact:

Dr. C. Daniel Miller, Executive Director
NASA Classroom of the Future
Wheeling Jesuit College
316 Washington Avenue
Wheeling, WV 26003
Phone: (304) 243-2388
FAX: (304) 243-2497
E-mail: cdmiller@cotf.edu

◆ Educational Technology

Endangered Species Tracking

Objective:

To provide the K-12 education community with current position data on endangered sea turtles and manatees for real-time tracking.

Description:

Endangered species tracking is made possible through a cooperative effort among several federal agencies located at the John C. Stennis Space Center.

Sea turtles in the Atlantic along the Florida and Georgia coast, wild geese in south Louisiana, and manatees in south Florida and Puerto Rico have transmitters attached to them that transmit data from which position (longitude and latitude) can be calculated. This data is received by National Oceanic and Atmospheric Administration (NOAA) satellite and retransmitted to the National Marine Fisheries Service receiving station at Stennis Space center. It will be made available to teachers through the Tri-State BBS and Internet. Students can then track the movements of "Tommy the Turtle" or "Molly the Manatee" periodically and perhaps determine the nature of its wintering, mating, and feeding habits over the course of a year.

Additional Information:

NASA Teacher Resource Center
John C. Stennis Space Center
Building 1200
Stennis Space Center, Mississippi 39529-6000
Phone: (601) 688-3338

GeoMap

Objective:

To provide teachers and students with an easy-to-use Geographic Information System (GIS) software package developed specifically for the K-12 education community.

Description:

GeoMap provides an intuitive Graphical User Interface (GUI) allowing students to quickly display and manipulate line graph maps. These maps use line data from the U.S. Geological Survey (USGS) to display maps of the conterminous United States and Hawaii. The application and maps are distributed on floppies and CD-ROMs. The *GeoMap* program can render any Geo-referenced (by latitude and longitude) data allowing it to handle information from environmental data collection sites, severe weather tracking, endangered species monitoring, etc.

On start-up the map depicts the state lines and islands for whatever map is being displayed. Users interact with the map by zooming in and out as desired with the mouse and by turning on attributes of the map. These attributes depict interstate highways, roads, rivers, lakes, etc. *GeoMap* in its current configuration has 12 attributes built in.

Users can measure linear distances, rectangular areas and cumulative distances, and can place connected lines and iconic labels (with a single line of text attached) anywhere on the map. This information can be saved as a User Map file that contains the zoom state and user entered graphics information. The User Map file is launched just as a regular map file and loads the associated map and overlays the user information. Any map can be stored on the Macintosh clipboard or saved as a file for export to other graphics packages.

GeoMap has the capability to perform basic sound, static image, and multimedia movie functions. This capability results in an almanac-like interface increasing the educational potential of the overall product.

These basic functions have been used to develop lesson plans through the Teacher Resource Center (TRC) at Stennis Space Center and are available for use in K-12 curriculum for educating students on map making and other subjects.

Additional Information:

NASA Teacher Resource Center
John C. Stennis Space Center
Building 1200
Stennis Space Center, Mississippi 399529-6000
Phone: (601) 688-3338

◆ Educational Technology

Public Use of Remote-Sensing Data (RSD) Program

Objective:

To help develop applications and technologies to increase and enhance public use of Earth and space science data over the Internet.

Description:

NASA science missions, such as Mission to Planet Earth, are obtaining massive volumes of new data with unprecedented temporal, spectral, and spatial resolution. New networking technologies will play a critical role in dealing with the massive volumes of data and distributing it to traditionally unserved communities.

The RSD Program is designed to encourage the development of innovative applications of Earth and space science remote-sensing data. By stimulating broad public use, via the Internet, of the databases maintained by NASA and other agencies, the program strives to encourage schools, businesses, and citizens to access and use Earth and space science data, contribute to the implementation of a National Information Infrastructure, stimulate U.S. economic growth, and improve the quality of life.

Through a competitive announcement in late 1994, NASA selected several organizations to help develop applications and technologies as a part of the Agency's efforts to provide public use of Earth and space science data over the Internet. Some of the projects are joint ventures that will also receive funding through other sources. Many of the selected projects focus on the development of exciting K-12 education applications, which will help prepare young people for the challenges of the 21st Century.

Additional Information:

For more information on the RSD Program, please contact:

Dr. Fritz Hasler
Code 912
Goddard Space Flight Center
Greenbelt, Maryland 20771
E-mail: hasler@agnes.gsfc.nasa.gov
World Wide Web: <http://rsd.gsfc.gov>

An annotated list follows of the RSD grants and agreements, which focus on K-12 education.

Athena: Curriculum Development, Implementation and Support on the Internet -- A cooperative agreement between NASA and Science Applications International Corp., Seattle, WA. Associates include Northshore School District, Bothell, WA; Seattle Public Schools, Seattle, WA; Lake Washington School District, Kirkland, WA; Bellevue Public Schools, Bellevue, WA; and the Office of the Superintendent of Public Instruction, Olympia, WA. The project will develop curriculum materials integrating ocean, weather, land and space data for grades K-12.

Contact: Hugh Anderson
E-mail: hugh@nw.saic.com
World Wide Web: <http://inspire.ospi.wednet.edu:8001/>

- ♦ **Dissemination of Atmospheric Sciences and Space Sciences Data and Information for K-12 and the Public: A Pacific Northwest Approach** -- Focused primarily on the K-12 community, the University of Washington will tailor real-time and retrospective atmospheric sciences data to display and explore the meteorology of the Pacific NW and the Puget Sound region. Science, engineering and exploration themes from the Mars Pathfinder Mission in 1996 will be integrated into descriptive modules along with live data which will also be available to museums. Products will be tested in local schools, and then be made available for regional adaptations and national public access.

Contact: Norbert Untersteiner, Harry Edmon
E-mail: norbert@atmos.washington.edu, harry@atmos.washington.edu
World Wide Web: <http://www.atmos.washington.edu/k12>

- ♦ **Earth System Science Community Curriculum Testbed** -- A cooperative agreement between NASA and ECOlogic Corp., Washington, D.C. Gonzaga College High School, Washington, D.C., is an associate in this project. The effort will develop Internet access and curriculum materials for investigation-based Earth system science instruction by high school and college teachers. (See also description on page 41)

Contact: Michael Keeler
E-mail: keeler@ecologic.net
World Wide Web: <http://www.circles.org>

- ♦ **Enhancing the Teaching of Science in Elementary Education Through the Application of NASA Remote Sensing Data Bases and Internet Technology** -- A cooperative agreement between NASA and The Analytic Sciences Corporation (TASC), Arlington, Va., with support from Franconia, Virginia Elementary School and the Fairfax, Virginia County School District. TASC will develop a Friendly Internet Front End, or FIFE, to provide students easy access to NASA and other Government remote-sensing databases. Remotely-sensed data available through this project will include satellite imagery and ground-based weather radar data. The FIFE will simplify the complex data and imagery and make it understandable, useful, and more visually-appealing to young students. Children will be able to track storms, prepare weather maps, and answer weather-related questions posed by teachers. During the three-year project TASC will tailor FIFE based on actual classroom use and eventually make the system available to other schools over the Internet. The targeted level for this weather-based curriculum is grades K-6.

Contact: David Zink
E-mail: dzinc@tasc.com

- ♦ **Exploring the Environment** -- A cooperative agreement with the NASA Classroom of the Future at Wheeling Jesuit College, Wheeling, W.Va. The project will develop computer software modules for use by high school students and teachers investigating Earth-science questions via extended inquiries over the Internet. (See also description on page 58)

Contact: Robert Myers
E-mail: bmyers@cotf.edu
World Wide Web: <http://cotf.edu/ETE/etehome>

- ♦ **Passport to Knowledge: Electronic Field Trips to Scientific Frontiers via Interactive TV and the Internet** -- A cooperative agreement between NASA and The Childhood Project, Inc., Summit, NJ. The NASA-funded portion of this project will use the Internet to provide on-line access to scientists' diaries and other curriculum materials in

◆ Educational Technology

support of live, national, interactive television field trips to the Antarctic, the Kuiper Observatory, and the Hubble Space Telescope.

Contact: Geoffrey Haines-Stiles

E-mail: ghstiles@ll.pbs.org

World Wide Web: <http://quest.arc.nasa.gov/livefrom/livefrom.html>

- ◆ **Public Access to Earth and Space Science Data Via Television** -- A cooperative agreement between NASA and WRC-TV, Washington, D.C. Partners in this endeavor include the NASA Jet Propulsion Laboratory, Pasadena, California; NASA Stennis Space Center, Mississippi; and the National Oceanic and Atmospheric Administration's National Weather Service, Washington, D.C. The project will develop visualizations of current Earth and space science data to be included as part of the daily weather and news reports for WRC-TV and other NBC affiliates. More importantly, the data also will be available over the Internet for use in schools nationwide.

Contact: David Jones

E-mail: jonedwa@tvswrc.nbc.ge.com

- ◆ **A Science Infrastructure for Access to Earth and Space Science Data Through the Nation's Science Museums** -- A grant to the University of California, Berkeley, to create a national science information infrastructure, a natural partnering of science museums, teachers and research institutions to stimulate public awareness and use of remote-sensing data and to deliver this information to the general community. This project presents a consortium of museums which include the Smithsonian Astrophysical Observatory, Cambridge, MA; Lawrence Hall of Science, Berkeley, CA; Boston Museum of Science, Boston, MA; The Exploratorium, San Francisco, CA; National Air and Space Museum, Washington, DC; New York Hall of Science, Flushing Meadows Corona Park, NY; and Science Museum of Virginia, Richmond, VA.

Contact: Carol Christian

E-mail: carolc@cea.berkeley.edu

World Wide Web: <http://www.cea.berkeley.edu/Education/SII/SII.html>

- ◆ **Surfing the Net: Aquatic Applications of Archival Satellite Imagery** -- A cooperative agreement between NASA and the Gulf of Maine Aquarium, Portland. This project will develop innovative K-12 learning activities using on-line data to investigate the land-sea interface, oceanographic applications, and studies of the effect of human activities on the environment. Early efforts will be tested by classes in the Yarmouth, ME, school district.

Contact: Alan Lishness

E-mail: lishness@saturn.caps.maine.edu

- ◆ **Using Science and the Internet as Everyday Classroom Tools** -- The Smithsonian Astrophysical Observatory, in collaboration with AT&T, Tenon Intersystems, and two Massachusetts elementary schools, is developing a hands-on astronomy curricular theme that integrates space science data and Internet/computer activities into the everyday life of the elementary school classroom. Age-appropriate astronomical data analysis programs will be developed and integrated into SAO's research-quality image display program to provide a complete graphical analysis environment for students. Curriculum and software will be made available through the Internet, NASA Teacher Resource Centers, and the Smithsonian Institution.

6?

Contacts: Eric Mandel, Kimberly Dow

E-mail: eric@head-cfa.harvard.edu, kdow@head-cfa.harvard.edu

WWW: <http://hea-www.harvard.edu/EverydayClassroomTools/HomePage.html>

- ♦ ***Virtually Hawaii*** -- The Hawaii Space Grant Consortium, University of Hawaii, in collaboration with NASA Goddard Space Flight Center and TerraSystems Inc., Hawaii, is developing an electronic information and data system for access to data focused on the State of Hawaii. Included in this project are the development of a data base of satellite and aircraft remote-sensing images for the entire state to promote tourism and small businesses in Hawaii; the real-time collection and distribution of weather satellite data and video over the Internet for use in a cable TV weather show; and the development of "virtual field trips" for use by any educator as educational modules related to the study of land, weather, and oceans.

Contact: Peter Mougini-Mark

E-mail: pmm@kahana.pgd.hawaii.edu

World Wide Web: <http://satftp.soest.hawaii.edu/space/hawaii/index.html>

- ♦ ***VolcanoWorld*** -- A grant awarded to the University of North Dakota, Grand Forks, ND. Other participants include Lincoln Elementary School, Grand Forks, ND; University of Hawaii, Honolulu, HI; Educational Services District 112, Vancouver, WA; Hawaii Volcanoes National Park; and Gifford Pinchot National Forest, USDA Forest Service, Vancouver, WA. Volcanoes are one of the most dramatic phenomena in nature, attracting millions of visitors each year to national parks, and fascinating millions more students in school science courses. The VolcanoWorld project is working to enrich the learning experiences of these groups by delivering high-quality, remote-sensing images; other data; and interactive experiences that add depth, variety and currency to existing volcano information sources. Right now, VolcanoWorld is only available over the Internet, but in the future much standard material will be provided on CD-ROMs and the project will use the Internet for automated downloading of information to users' computers.

Contact: Charles A. Wood

E-mail: cwood@badlands.nodak.edu

World Wide Web: <http://volcano.und.nodak.edu>

- ♦ ***Windows to the Universe - An Earth and Space Science Internet-Based Active Learning System for the General Public*** -- A grant to the University of Michigan to create a learning system for the Earth and space sciences using hypertext, images, simulation-guided animations, voice overlays, and digital data resources to be implemented in museums, libraries, and classrooms nationwide. Collaborators in this project include the NASA Jet Propulsion Laboratory, NASA Goddard Space Flight Center, the Ann Arbor Hands-On Museum, and Turn of the Century Software. Additional future participants under consideration include, the Cranbrook Institute of Science, Bloomfield Hills, MI, and the Ann Arbor Public Schools.

Contact: Roberta A. Johnson

E-mail: rjohnson@sprlc.sprl.umich.edu

Resources

Mission to Planet Earth Education Materials

- ♦ Teacher's Guides with Classroom Activities, 70
- ♦ Lithographs with Classroom Activities, 71
- ♦ NASA Facts, 72
- ♦ Posters, 72
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A listing of Mission to Planet Earth education materials is provided in this section. Unless noted otherwise, the following materials are available through the NASA Teacher Resource Center (TRC) Network. Please see page 80, for information on the NASA TRC Network.

BEST COPY AVAILABLE

◆ Resources

Teacher's Guides with Classroom Activities

Elementary

- ◆ *Our Mission to Planet Earth: A Guide to Teaching Earth System Science* (EP-292) provides hands-on activities and information related to studying the Earth system. Its primary goal is for children to become familiar with the concept of cycles and to learn that some human activities can cause changes in their environment. Recommended level: grades K-3.
- ◆ *Ground Truth Studies Handbook* is a curriculum developed by the Aspen Global Change Institute (AGCI) through NASA funding. Available for \$19.95 from the Aspen Global Change Institute, 100 East Francis Street, Aspen, Colorado 81611. Sample lesson plans from the handbook are also available on AGCI's home page on the World Wide Web: <http://infosphere.com/clients/smallworks/agci/>. Recommended level: grades K-12.

Middle School

- ◆ *ATLAS 1 Earth's Mysterious Atmosphere Teacher's Guide* (EP-282/11/91) is based upon the Atmospheric Laboratory for Applications and Science 1 (ATLAS 1) Space Shuttle experiment. This teacher's guide blends lessons in chemistry, physics, and the life, Earth, and space sciences. The guide is set up as a mystery with cases, clues, procedures, and questions. Recommended level: grades 6-8.
- ◆ *La misteriosa atmosfera de la Tierra* (EP290/03/93) contains excerpts, in Spanish, from the ATLAS 1 Teachers Guide (above). Recommended level: grades 6-8.
- ◆ *ATLAS 2 Teacher's Guide with Activities: Atmospheric Detectives* (EP285/11-92) probes the connection between the activities of scientists and researchers and the observable world of weather and climate. The guide is set up as a mystery with cases, clues, procedures, and questions. Based upon the ATLAS 1 and ATLAS 2 Space Shuttle experiments. Recommended level: grades 6-8.
- ◆ *Mission EarthBound Teachers Guide* (EP-208/1/94) was produced to support *Mission EarthBound*, a series of six interactive videoconferences for teachers of grades 4-8 that was originally broadcast during the 1993/94 school year. The series was developed by NASA Langley Research Center in collaboration with Old Dominion University and the Virginia Space Grant Consortium. This award-winning series examined

global atmospheric science issues using NASA satellite, airborne, and ground-based measurements. It explored changes and challenges facing Earth's inhabitants through simulations of visiting "alien" students who must use problem-based reasoning techniques to assess the Earth situation. Copies of the video series and teacher's guide are available from NASA Central Operation of Resources for Educators (see page 93). Recommended level: grades 4-8.

High School

- ♦ *The Living Ocean, SeaWiFS: Studying Ocean Color from Space* (EP-307/1/94) contains background information and activities related to studying ocean biology from space. Note: The information and activities in this guide are related to the poster, *The Living Ocean* (WAL-145, February 1994). Recommended level: grades 9-10.
- ♦ *Looking at Earth from Space* (EP 300-303) is a series of publications on the topic of using meteorological satellite imagery to study science and mathematics. The series includes *Direct Readout from Environmental Satellites* (EP-300); *A Guide to Equipment and Vendors* (EP-301); *Glossary of Terms* (EP-302); and *Teachers Guide with Activities* (EP-303). Recommended level: grades 5-12.
- ♦ *Space Age Activity Guide* contains 24 cooperative-learning activities on such topics as gravity, orbits, launch sites, ecosystems, climate, the Moon, Mars, satellites, and more. These activities complement the topics of the Space Age television series that was originally broadcast during 1992. Space Age was a production of WQED/Pittsburgh and NHK Japan in association with the National Academy of Sciences. NASA provided funding for educational activities and outreach. The Space Age Activity Guide is available on NASA Spacelink (see page 89). Recommended level: grades 6-12.

Lithographs with Classroom Activities

- ♦ Earth View (HqI-331)
- ♦ First Image of the Global Biosphere (HqI-325)
- ♦ Nimbus-7 TOMS Images: The Eight Marches (HqI-366)
- ♦ Nimbus-7 Ocean Ice Maps (HqI-319.1)
- ♦ TOMS Ozone - Difference from Climatology (HqL-371)
- ♦ Water is a Force of Change (HqI-401)

In addition, a limited supply of lithographs presenting initial research findings and imagery from the TOPEX/POSEIDON and Shuttle Imaging

◆ Resources

Radar (SIR-C/X-SAR) missions are available from the JPL Public Information Office, Mail Stop 186-120, 4800 Oak Grove Drive, Pasadena, California 91109.

NASA Facts

NASA Facts are educational brochures that provide general information and background on NASA-related missions, research topics, and activities. The Mission to Planet Earth Series of NASA Facts was produced in an effort to educate the general public concerning some of the issues and the natural phenomena that scientists will be studying using data provided by MTPE. The series is also available on the Internet at the following World Wide Web server: <http://spso.gsfc.nasa.gov>.

- ◆ Ozone: What it is, and why do we care about it? - NF-198, December 1993
- ◆ Clouds and the Energy Cycle - NF-207, January 1994
- ◆ Polar Ice - NF-212, February 1994
- ◆ El Niño - NF-211, February 1994
- ◆ Volcanoes and Global Climate Change, - NF-220, March 1994
- ◆ Global Warming - NF-222, March 1994
- ◆ Biosphere - NF-223, March 1994

Posters

- ◆ *Corcoran Posters on Global Change.* The graphic design students at the Corcoran School of Art and scientists from NASA collaborated to produce a series of seven posters illustrating important issues in Earth system science. The posters include: biosphere, clouds, El Niño, global warming, ozone, polar ice, and volcanoes.
- ◆ *Earth's Changing Atmosphere: Investigating its Mysteries.* The back of the poster is laid out with nine standard-sized pages, which provide information and activities related to studying Earth's atmosphere, including atmospheric gases, ozone, solar cycles, tracking short-term weather changes, and resources for educators. Recommended level: grades 6-8.
- ◆ *The Living Ocean: SeaWiFS Poster Ocean* (WAL-145, February 1994). Note: The information and activities in this guide are related to the teachers' guide, *The Living Ocean, SeaWiFS: Studying Ocean Color from Space* (EP-307/1/94).

- ♦ *Perspectives from Space.* NASA developed this set of eight posters in celebration of the 1992 International Space Year. Each poster represents a specific perspective gained through space exploration and research. The back of each poster is laid out with four standard letter-sized pages, which describe science concepts related to the perspectives illustrated on the front, as well as suggested classroom activities. The first poster in the set examines the topic of Earth system science. Recommended level: grade 9-12. (Limited supply)
- ♦ *Planet Earth (WED-119)* depicts a Geostationary Operational Environmental Satellite (GOES) -8 image of the Earth. The back of the poster is divided into five sections including classroom activities concerning saving our planet, atmosphere, land, and oceans.
- ♦ *TOMS Ozone Poster (WAL-144, January 1994)* shows measured total ozone levels over the Earth, for each month, from November 1978 to April 1993. The measurements were taken by the Nimbus-7 TOMS instrument. The flip side of the poster contains background information on ozone and classroom activities.

Slide Sets

The following 35mm slide sets are available for purchase from NASA CORE (see page 93). Please note that slide sets are also available for copying by bringing blank slide film into your nearest NASA Teacher Resource Center (see page 81).

- ♦ *ATLAS 1: Studying Mysteries in the Earth's Atmosphere*, includes 20 slides and activity book for grades 6-8. Describes the first ATLAS mission, which was dedicated to a better understanding of the physics and chemistry of Earth's atmosphere. (\$8.50, plus \$4.50 shipping within the U.S.)
- ♦ *Earth/Space Science Slide Set for Educators*, was designed to provide educators with some of the most-recent, space-based observations NASA has obtained in the area of Earth system science. 122 slides and background information are provided on the following themes that are considered of primary importance to Earth system science research: Clouds and Radiation; Ocean Productivity, Circulation, and Sea-Air Exchange; Greenhouse Gases; Changes in Land Use, Land Cover, Primary Productivity, and the Water Cycle; The Role of the Polar Ice Sheets and Sea Level; Ozone Depletion; and the role of Volcanoes in Climate Change. Recommended level: Grade 9-Adult. (\$60, plus \$6 shipping within the U.S.).

◆ Resources

- ◆ *Full Earth*, contains six slides with descriptions of photographs of Earth taken by various satellites and Apollo missions. Provided by NASA Public Affairs. (\$3.50 plus \$4.50 shipping within the U.S.)
- ◆ *Volcanoes of Hawaii and the Planets*, includes 20 slides with descriptions. Compares landforms in Hawaii and on the planets. Prepared by Dr. Peter Mouginiis-Mark for the Hawaii Space Grant Consortium. (\$8, plus \$4.50 shipping within the U.S.)

Videotapes

The following are selected videotapes related to MTPE, which are available for purchase from NASA CORE. Please see page 93, for information about ordering materials from CORE. Also, note that videotapes are available for copying by bringing a blank videotape into your nearest NASA Teacher Resource Center (see page 81).

- ◆ *Blue Planet* (1990) was filmed by astronauts from five Space Shuttle missions. This IMAX film dramatically reveals the forces affecting the Earth's ecological balance: volcanoes, hurricanes, earthquakes, and, ultimately, humankind. Length: 42:00; recommended level: grade 4-Adult. (1/2" VHS--\$30, plus shipping).
- ◆ *Lasers: Learning with Light* (1995) explains cutting edge NASA research, including: the development of laser-based warning systems for detection of windshear, a weather hazard blamed for many airplane crashes; the Lidar In-Space Technology Experiment (LITE) -- a light detection and ranging system that uses a three-wavelength laser for measurements of aerosol, cloud, and atmospheric density profiles; Shuttle and satellite-based laser ranging systems which perform geodynamic studies possibly leading to earthquake prediction abilities. Part of the NASA Education Videoconference series (see full description of this series on page 92). Length: 60:00; recommended level: grade 9-adult. (1/2" VHS--\$21; 3/4" UMATIC--\$40, plus shipping)
- ◆ *Liftoff to Learning: The Atmosphere Below* (1992) illustrates how changes in the Earth's atmosphere are investigated from outer space onboard the Space Shuttle using the ATLAS-1 experiment. Space Shuttle astronauts explain the questions scientists seek to answer by studying the Earth's atmosphere from space. Experiments discussed in this videotape focus on infrared detection of atmospheric remnants from volcanic eruptions, ozone concentration levels, and incoming solar ultraviolet radiation in respect to global warming. Includes a video

resource guide for teachers. Length: 16:00; recommended level: grades 5-12. (1/2" VHS--\$15; 3/4" UMATIC--\$25, plus shipping)

- ♦ *Live from Antarctica* (1994/1995) was a four-part videoconference series, consisting of the following 60 minute programs: 1. The Coldest, Windiest, Iciest Place on Earth; 2. Life in Antarctica, Then and Now; 3. Spaceship South Pole; 4. From Pole to Planet. Length: 4 hours; Recommended level: grades 6-12. (1/2 " VHS--\$40, plus shipping)

- ♦ *Mission EarthBound* (1993/1994) was a series of six interactive videoconferences for teachers of grades 4-8 that was originally broadcast during the 1993/94 school year. This award-winning series included the following 60-minute programs: 1. Preview of the entire Mission EarthBound series; 2. The Earth's Atmosphere-A Cosmic Perspective (The origin of the Earth, the atmosphere, and life); 3. Atmospheric Ozone-What Is It and What Is Happening to It?; 4. The Climate System and Climate Modeling; 5. Greenhouse Gases and Climate Change; and 6. Challenges and Solutions to Global Atmospheric Change. Length: 6 hours. Recommended level: grades 4-8. (1/2 " VHS--\$60, plus shipping)

- ♦ *TOPEX/POSEIDON: A Mission to Planet Earth* (1992) explains the objectives of the joint U.S./French mission dedicated to studying the circulation of the Earth's oceans. The satellite was launched during 1992 and is vastly improving our understanding of the ocean's role in global climate change, laying the foundation for long-term oceans monitoring from space. Length: 9:00; recommended level: grades 9-adult. (1/2" VHS--\$10; 3/4" UMATIC--\$20, plus shipping)

- ♦ *Sunsplash* (New in late 1995) explains ozone depletion, using computer graphics and animation. The educational narrative explains how ozone in the stratosphere protects us from ultraviolet radiation and demonstrates how chlorofluorocarbons (CFCs) cause destruction of the Earth's protective ozone layer. Length: 7:52; recommended level: grades 9-12.

- ♦ *The Whole World in Your Hands -- Earth Observing System Data and Information System* (1995). Everyday, Earth faces environmental change. This program examines one component of worldwide efforts to understand and predict such change: NASA's Earth Observing System (EOS), an array of global observation satellites. It focuses on how the EOS Data and Information System (EOSDIS) controls EOS instruments to process, archive, manage, and distribute instrument data using one of the most complex computer networks ever developed. The video also

◆ Resources

includes information on how to tap into EOSDIS Data Centers from school computers, classroom activities, and other resources. Part of the NASA Education Satellite Videoconference Series (see full description of this series on page 92). Length: 60:00; recommended level: grade 9-adult. (1/2" VHS--\$21; 3/4" UMATIC--\$40, plus shipping)

Educational Technology

- ◆ *Bird-Dog Satellite Tracking Program.* This computer program was developed by the Environmental Research Institute of Michigan and is available through NASA Spacelink. Bird-Dog was designed as a tool for teaching basic orbital mechanics of weather satellites and as a tool to supplement a direct readout ground station. Bird-Dog can be used to accurately predict satellite passes and data acquisition windows, as well as to graphically depict the position of the satellite being monitored. The minimum system requirements are: IBM-compatible with 256K memory and an EGA graphics card.
- ◆ *Earth Observation Images on Laser Videodisc.* Over 150,000 astronaut photos of the Earth are currently available on two 12-inch laser videodiscs. These images can be used to enhance Earth science teaching from kindergarten to graduate school. Seen in these photos are volcanic eruptions, transatlantic duststorms, continental-scale smoke palls, deforestation grids in the rain forests of Brazil, the bleeding of Madagascar's red soil out the Betsiboka Estuary, plankton blooms tens of miles long, the rise of the Great Salt Lake, the fall of the Aral Sea, and the effects of El Niños--from droughts in Australia to floods in California.

Disc 1 covers the first 44 Space Shuttle missions (1981 - 1991). Disc 2 continues with the next 13 Space Shuttle missions (1992 - 1993) and, in a few thousand press release images, extends the record back in time from the Space Shuttle in 1993 through Skylab and Apollo and Gemini to Mercury in 1961.

Each disc comes with a Guide to Images booklet and IBM-formatted diskettes, containing data records. Available from NASA CORE (see page 93). Disc 1--\$55, plus shipping; Disc 2 -- \$55, plus shipping.

- ♦ *Interactive NOVA: Earth.* The fourth in a series of *Interactive NOVAs*, the *Earth* videodisk was jointly developed by NASA and the WGBH educational foundation. *Interactive NOVA: Earth* focuses on studying the Earth system, beginning with the question, "What makes Earth a good home?" Two levels of the product are produced: Level 1-- no computer required and Level 3--full interactive version for use with a Macintosh computer. Available from Scholastic Publications, Inc.; preview copies are available for viewing at NASA Teacher Resource Centers (see page 81).
- ♦ *NASA Satellite Videoconferences for Educators.* A number of these interactive videoconferences have focused on MTPE, including broadcasts on April 14, 1993 ("Mission to Planet Earth"), October 5, 1993 ("Mission to Planet Earth 2"), and March 16, 1995 ("The Whole World in Your Hands: Earth Observing System Data and Information System"). Copies of NASA educational satellite videoconferences are available from NASA CORE. For more information on the NASA Education Satellite Videoconferences Series, see page 92.
- ♦ *The SIR-C Education Program (SIR-CED)* was produced by NASA's Jet Propulsion Laboratory as a two- to three-week module for middle school and high school students. The SIR-CED package has also been used to teach undergraduate, non-science majors. It includes two educational CD-ROMs; a teachers' guide with lesson plans; and a videotape. The package is based upon radar images generated by the Shuttle Imaging Radar (SIR)-C instrument flown on the Space Shuttle in April and October 1994. These images are used by scientists to help understand global processes, such as deforestation in the Amazon, desertification south of the Sahara, and soil moisture retention in the midwest United States. Students receive some training in understanding, displaying, and analyzing radar images, then may choose their own research project to explore further. The package is available from NASA CORE (see page 93) and can be used on Macintosh, SUN, and IBM PC computers. The teachers guide and lesson plans from SIR-CED are also available on-line at the following World Wide Web site:

<http://ericir.syr.edu/NASA/nasa.html>

The NASA/JPL Imaging Radar Home Page contains a radar remote-sensing science and applications section where the SIR-CED CD-ROM can be viewed on-line. (See page 101)

◆ Resources

General Brochures

- ◆ *NASA's Mission to Planet Earth: Earth Observing System*, PAM-552
- ◆ *Mission to Planet Earth: A Program to Understand Global Environmental Change*, PAM-556/1-94

General NASA Resources for Teachers and Students

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NASA's national education program is carried out through NASA Headquarters and the NASA Field Centers. In addition to direct interaction between educators, students, and personnel at the Field Centers, NASA provides information, materials, and services to the larger education community through a multifaceted dissemination network. NASA's national dissemination plan has established two priority areas and actions to improve service to the education community:

- ♦ a physical presence in each state (through the NASA Teacher Resource Center Network, precollege outreach programs, and the Space Grant College and Fellowship Program)
- ♦ electronic information systems (NASA Television, NASA Spacelink, and FEDIX)

◆ Resources

Through the **NASA Teacher Resource Center Network**, educators can enhance their existing curriculum with information generated by NASA programs, technologies, and discoveries. Although NASA educational materials relate primarily to mathematics, science, and technology, they can be valuable curriculum supplements for all subjects.

To help disseminate these materials to educators, NASA's Education Division has established the NASA Teacher Resource Center Network. This network is composed of Teacher Resource Centers (TRC's), Regional Teacher Resource Centers (RTRC's), and the NASA Central Operation of Resources for Educators (CORE). These facilities are the principal distribution points where educators may copy NASA text, audio, visual, and computer materials.

TRCs are located on or near NASA Field Centers, and they offer a variety of NASA-related educational materials in several formats: videotapes, slide sets, audio tapes, and publications including teacher guides with activities. A list of TRCs begins on page 81. To offer more educators the opportunity to utilize the network, NASA forms partnerships with school systems, universities, planetariums, museums, and other nonprofit organizations to serve as RTRCs. Teachers may preview, copy, or receive NASA materials at these sites. A list of RTRCs begins on page 82. CORE is a worldwide distribution center for NASA's audiovisual educational materials. See page 93 for information about NASA CORE.

Teacher Resource Centers (TRC's):

If You Live In:

Alaska	Nevada
Arizona	Oregon
California	Utah
Hawaii	Washington
Idaho	Wyoming
Montana	

California
(Mainly cities near Dryden
Flight Research Facility)

Connecticut	New Hampshire
Delaware	New Jersey
District of Columbia	New York
Maine	Pennsylvania
Maryland	Rhode Island
Massachusetts	Vermont

Virginia's and
Maryland's Eastern
Shores

Serves inquiries related to
space and planetary
exploration.

Florida
Georgia
Puerto Rico
Virgin Islands

Colorado	North Dakota
Kansas	Oklahoma
Nebraska	South Dakota
New Mexico	Texas

TRC:

NASA Ames Research Center
Teacher Resource Center
Mail Stop T12-A
Moffett Field, CA 94035-1000
(415) 604-3574

NASA Dryden Flight Research Facility
Public Affairs Office (Trl. 42)
Teacher Resource Center
Edwards AFB, CA 93523-0273
(805) 258-3456

NASA Goddard Space Flight Center
Teacher Resource Laboratory
Mail Code 130.3
Greenbelt, MD 20771-1000
(301) 286-8570

**NASA Goddard Space Flight Center
Wallops Flight Facility**
Education Complex—Visitor Center
Teacher Resource Lab
Bldg. J-17
Wallops Island, VA 23337-5099
(804) 824-2297/2298

NASA Jet Propulsion Laboratory
Teacher Resource Center
JPL Educational Outreach
4800 Oak Grove Drive
Mail Code CS-530
Pasadena, CA 91109-8099
(818) 354-6916

NASA John F. Kennedy Space Center
Educators Resources Laboratory
Mail Code ERL
Kennedy Space Center, FL 32899-0001
(407) 867-4090

NASA Johnson Space Center
Teacher Resource Center
Mail Code AP 2
Houston, TX 77058-3696
(713) 483-8696

◆ Resources

If You Live In:

Kentucky
North Carolina
South Carolina
Virginia
West Virginia

Illinois
Indiana
Michigan
Minnesota
Ohio
Wisconsin

Alabama
Arkansas
Iowa
Louisiana
Missouri
Tennessee

Mississippi

TRC:

NASA Teacher Resource Center
for **Langley Research Center**
Virginia Air and Space Center
600 Settler's Landing Road
Hampton, VA 23669-4033
(804) 727-0900 X757/(804) 727-0800 x 757

NASA Lewis Research Center
Teacher Resource Center
Mail Stop 8-1
21000 Brookpark Road
Cleveland, OH 44135-3191
(216) 433-2017

NASA Teacher Resource Center
for **Marshall Space Flight Center**
U.S. Space & Rocket Center
P.O. Box 070015
Huntsville, AL 35807-7015
(205) 544-5812

NASA Stennis Space Center
Teacher Resource Center
Building 1200
Stennis Space Center, MS 39529-6000
(601) 688-3338

Regional Teacher Resource Centers

Alabama

Tri-State Learning Center
NASA Teacher Resource Center
P.O. Box 508
Iuka, MS 38852-0508
(601) 423-7455

Alaska

Alaska Science Center
NASA Regional Teacher Resource Center
Alaska Pacific University
4101 University Drive
Anchorage, AK 99508
(907) 564-8207

Arizona

Lunar and Planetary Lab
NASA Regional Teacher Resource Center
University of Arizona
Tucson, AZ 85721-0001
(602) 621-6939/6947

Arkansas

University of Arkansas-Little Rock
Natural Science Bldg., Room 215
2801 South University
Little Rock, AR 72204
(501) 569-3259

California

NASA San Joaquin Valley Regional
Teacher Resource Center
California State University, Fresno
Mail Stop 01
5005 N. Maple Avenue
Fresno, CA 93740-0001
(209) 278-0355

Colorado

U.S. Space Foundation
NASA Regional Teacher Resource Center
2860 S. Circle Drive Suite 2301
Colorado Springs, CO 80906-4184
(719) 576-8000

Delaware

Delaware Aerospace Center
Claymont Education Campus
NASA Regional Teacher Resource Center
3401 Green Street
Claymont, Delaware 19703
(302) 792-3806

District of Columbia

National Air and Space Museum
Smithsonian Institution
Education Resource Center, MRC-305
Washington, DC 20560
(202) 786-2109

University of the District of Columbia
NASA Regional Teacher Resource Center
Mail Stop 4201
4200 Connecticut Ave. N.W.
Washington, DC 20008
(202) 274-6287

Georgia

Southern College of Technology/GYSTC
1100 S. Marietta Parkway
Marietta, GA 30060-2896
(404) 528-6272

Hawaii

Barbers Point Elementary School
NASA Regional Teacher Resource Center
Boxer Road
Barbers Point Naval Air Station
Ewa Beach, HI 96706
(808) 673-7410

Idaho

University of Idaho at Moscow
NASA Regional Teacher Resource Center
ID Space Grant College Fellowship Program
College of Education
Moscow, ID 83843
(208) 885-6030

Illinois

Chicago Museum of Science and Industry
NASA Regional Teacher Resource Center
57th Street and Lakeshore Drive
Chicago, IL 60637-2093
(312) 684-1414 x 2426

Parks College of St. Louis University
NASA Regional Teacher Resource Center
Rt. 157 and Falling Springs Road
Cahokia, IL 62206
(618) 337-7500

Indiana

University of Evansville
NASA Regional Teacher Resource Center
School of Education, 1800 Lincoln Avenue
Evansville, IN 47722
(812) 479-2393

Iowa

University of Northern Iowa
NASA Regional Teacher Resource Center
IRTS, Room 222
Schindler Education Center
Cedar Falls, IA 50614-0009
(319) 273-6066

Kansas

Kansas Cosmosphere and Space Center
NASA Regional Teacher Resource Center
1100 North Plum
Hutchinson, KS 67501-1499
(316) 662-2305 or 1-800-397-0330

Kentucky

Murray State University
NASA Regional Teacher Resource Center
P.O. Box 9
University Library
Murray, KY 42071-0009
(502) 762-2850

Louisiana

Bossier Parish Community College
NASA Regional Teacher Resource Center
2719 Airline Drive
Bossier City, LA 71111
(318) 746-7754

Southern University - Shreveport
NASA Regional Teacher Resource Center
Downtown Metro Center
610 Texas Street
Shreveport, LA 71101
(318) 674-3444

◆ Resources

Michigan

Central Michigan University
NASA Regional Teacher Resource Center
Ronan Hall, Room 101
Mount Pleasant, MI 48859
(517) 774-4387

Northern Michigan University
NASA Regional Teacher Resource Center
Olson Library Media Center
Marquette, MI 49855
(906) 227-2270

Oakland University
NASA Regional Teacher Resource Center
O'Dowd Hall, Room 216
Rochester, MI 48309-4401
(313) 370-2485/4230

Minnesota

Mankato State University
NASA Regional Teacher Resource Center
Department of Curriculum and Instruction
MSU Box 52/P.O. Box 8400
Mankato, MN 56002-8400
(507) 389-1516

St. Cloud State University
Center for Information Media
NASA Regional Teacher Resource Center
720 4th Avenue South
St. Cloud, MN 56301
(612) 255-2062

Mississippi

Mississippi Delta Community College
NASA Regional Teacher Resource Center
P.O. Box 668
Moorhead, MS 38761
(601) 246-5631 x125

Tri-State Learning Center
NASA Teacher Resource Center
P.O. Box 508
Iuka, MS 38852-0508
(601) 423-7455

Montana

W. Montana College of the Univ. of Montana
NASA Regional Teacher Resource Center
Carson Library
710 South Atlantic
Dillon, MT 59725
(406) 683-7541

Nebraska

University of Nebraska State Museum
NASA Regional Teacher Resource Center
14th & U Streets
307 Morrill Hall
Lincoln, NE 68588-0338
(402) 472-6302

University of Nebraska at Omaha
Mallory Kountze Planetarium
Durham Science Center, Room 144
60th and Dodge Street
Omaha, NE 68182-0266
(402) 554-2510

Nevada

Community College of Southern Nevada
NASA/Nevada Regional Teacher Resource Center
C2A
Learning Resource Center
Room 2100 F
3200 E. Cheyanne Avenue
North Las Vegas, NV 89030-4296
(702) 651-4505

New Mexico

New Mexico State University
NASA Regional Teacher Resource Center
New Mexico Space Grant Consortium
Box 30001, Dept. SG
Las Cruces, NM 88003-0001
(505) 646-6414

University of New Mexico
NASA Regional Teacher Resource Center
Continuing Education and Community Service
1634 University N.E.
Albuquerque, NM 87131-4006
(505) 277-3861

New York

The City College
NASA Regional Teacher Resource Center
Harris Hall, Room 109
Convent Avenue at 138th Street
New York, NY 10031
(212) 650-6993

North Carolina

University of North Carolina - Charlotte
NASA Regional Teacher Resource Center
J. Murray Atkins Library
Charlotte, NC 28223
(704) 547-2559

North Dakota

University of North Dakota
NASA Regional Teacher Resource Center
The Wayne Peterson Room
Clifford Hall -- 5th Floor
Space Studies Department
P.O. Box 9008, University Station
Grand Forks, ND 58202-9008
(701) 777-4856 or
(800) 828-4274

Ohio

University of Cincinnati
NASA Regional Teacher Resource Center
Curriculum Resources Center Library
Mail Location 0219
600 Blegen Library
Cincinnati, OH 45221-0219
(513) 556-1430

Oklahoma

Oklahoma State University
NASA Aerospace Education Resource
Center
308A CITD
Stillwater, OK 74078-0422
(405) 744-7009

Oregon

Oregon Museum of Science and Industry
NASA Regional Teacher Resource Center
Science Program Department
1945 SE Water Avenue
Portland, OR 97214-3354
(503) 797-4579

Pennsylvania

University of Pittsburgh
School of Education
Computer Curriculum Information Center
NASA Regional Teacher Resource Center
230 S. Boquet Street
Pittsburgh, PA 15260
(412) 648-7560/7558

Rhode Island

Rhode Island College
NASA Regional Teacher Resource Center
Curriculum Resources Center
600 Mt. Pleasant Avenue
Providence, RI 02908
(401) 456-8567/8065

South Carolina

Stanback Planetarium
NASA Regional Teacher Resource Center
P.O. Box 7636
South Carolina State University
Orangeburg, SC 29117-7636
(803) 536-8709/7174/8119

South Dakota

NASA Regional Teacher Resource Center
1925 Plaza Boulevard
Rapid City, SD 57702
(605) 394-1876

Tennessee

Tri-State Learning Center
NASA Teacher Resource Center
P.O. Box 508
Iuka, MS 38852-0508
(601) 423-7455

University of Tennessee at Martin
NASA Regional Teacher Resource Center
Center for Excellence in Mathematics
and Science
Martin, TN 38238-5029
(901) 587-7191/7166

Texas

NASA Regional Teacher Resource Center
Education Service Center Region 12
P.O. Box 23409
Waco, TX 76702-3409
(817) 666-0707

Utah

Utah State University
College of Education
NASA Regional Teacher Resource Center
Logan, Utah 84322-2845
(801) 797-3377

◆ Resources

Weber State University
NASA Regional Teacher Resource Center
Curriculum Library
College of Education
Ogden, UT 84408-1302
(801) 626-7614/6279

Vermont

Norwich University
Vermont College Educational
Resource Center
NASA Regional Teacher Resource Center
Schulmaier Hall
Montpelier, VT 05602
(802) 828-8845

Virginia

Radford University
NASA Regional Teacher Resource Center
P.O. Box 6999 Walker Hall
Radford, VA 24142
(703) 831-6284

Washington

University of Washington
NASA Regional Teacher Resource Center
AK-50, c/o Geophysics Department
Seattle, WA 98195
(206) 543-1943

West Virginia

Wheeling Jesuit College
NASA Regional Teacher Resource Center
316 Washington Avenue
Wheeling, WV 26003
(304) 243-2401

Wisconsin

University of Wisconsin at LaCrosse
NASA Regional Teacher Resource Center
Morris Hall, Room 200
LaCrosse, WI 54601
(608) 785-8148/8650

Wyoming

University of Wyoming
NASA Regional Teacher Resource Center
Learning Resource Center
P.O. Box 3374 University Station
Laramie, WY 82071-3374
(307) 766-2527

Center Education Program Officers (Precollege)

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NASA Ames Research Center
Moffett Field, CA 94035-1000
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Kennedy Space Center, FL 32899-0001
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NASA Langley Research Center
Hampton, VA 23681-0001
Phone: (804) 864-3313
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◆ Resources

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Phone: (216) 433-2956

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University Affairs Officer
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Huntsville, AL 35812-0001
Phone: (205) 544-0997

Dr. Armond Joyce
University Affairs Officer
AA00/University Affairs Office
John C. Stennis Space Center
Stennis Space Center, MS 39529
Phone: (601) 688-3830
E-mail: ajoyce@wpogate.ssc.nasa.gov

NASA Spacelink

NASA Spacelink is an electronic information system that contains a wealth of factual information on the U.S. Space Program, along with educational

◆ Resources

materials that can be used by teachers at all levels to supplement lessons in mathematics, science, technology, and other disciplines.

A special feature of NASA Spacelink is the "Spacelink Teacher Resource Center" (STRC), a restricted application available only to teachers who obtain a Spacelink Educator Account. The STRC provides extended access to other NASA electronic resources, and promotes the exchange of ideas with NASA and other educators. NASA Spacelink contains extensive information on MTPE, and for teachers who obtain STRC accounts, the system provides links to all the NASA MTPE information servers described in this catalog. To obtain a Spacelink Educator Account, send your request on school letterhead to the Spacelink Administrator at the address provided below. NASA Spacelink may be accessed by computer through direct-dial modem or the Internet:

Direct-dial modem line: (205) 895-0028
Terminal emulation: VT-100 is required
Data format: 8-None-1
Baud rate: Up to 14.4K bps

Spacelink fully supports the following Internet services:

World Wide Web: <http://spacelink.msfc.nasa.gov>
Anonymous FTP: [spacelink.msfc.nasa.gov](ftp://spacelink.msfc.nasa.gov)
Gopher: [spacelink.msfc.nasa.gov](gopher://spacelink.msfc.nasa.gov)
Telnet: [spacelink.msfc.nasa.gov](telnet://spacelink.msfc.nasa.gov)
TCP/IP address: 192.149.89.61

For more information, contact:

Spacelink Administrator
NASA Marshall Space Flight Center
Mail Code CL01
Huntsville, AL 35812-0001
Phone: (205) 544-6360
E-mail: comments@spacelink.msfc.nasa.gov

FEDIX

FEDIX, an on-line service developed by the Federal Information Exchange, Inc., is an information link between the Federal Government and academia.

FEDIX data bases provide on-line information on Federal research and educational opportunities, program contacts, scholarships, research equipment, and minority opportunities. An electronic mail feature allows users to communicate with the system operators. The FEDIX system:

- ♦ Provides access at no cost, is easy to use, and has no registration fees.
- ♦ Offers a comprehensive source for participating agencies' research and educational opportunities.
- ♦ Provides the latest information on participating agencies and minority institutions.
- ♦ Updates daily information available from the Commerce Business Daily and the Federal Register.

Any microcomputer or terminal with communications software and a modem operating at 1200, 2400, or 9600 baud, or any computer that has access to Internet can connect to the system.

Telnet: fedix.fie.com or 192.111.228.33
At login type: fedix
Modem Line: (301) 258-0953 or (800) 783-3349
Data Format: 8 data bits, no parity, 1 stop bit
Gopher: fedix.fie.com
World Wide Web: <http://web.fie.com>

A free user guide is available by calling: (301) 975-0103.

NASA Television

NASA Television is the Agency's distribution system for live and taped programs. It offers the public a front-row seat for launches and missions, as well as informational and educational programming, historical documentaries, and updates on the latest developments in aeronautics and space science.

The educational programming is aimed at inspiring students to achieve, especially in science, mathematics, and technology. If your school's cable television system carries NASA TV, or if your school has access to a satellite dish, the programs may be down-linked and videotaped. Daily and monthly programming schedules for NASA Television are also available via NASA Spacelink (see page 89).

NASA Television is transmitted on Spacenet 2 (a C-band satellite) on transponder 5, channel 8, 69 degrees West with horizontal polarization, frequency 3880.0 Megahertz, audio on 6.8 Megahertz.

For more information, contact:

NASA Headquarters
Technology and Evaluation Branch
Code FET
Washington, DC 20546-0001

◆ Resources

Education Satellite Videoconference Series for Teachers

The Education Satellite Videoconference Series for Teachers is offered as an in-service education program for educators through the school year. The content of each program varies, but includes aeronautics or space science topics of interest to elementary and secondary teachers. NASA program managers, scientists, astronauts, and education specialists are featured presenters. The conferences are live and interactive; educators can call the studio to ask questions. Components of the videoconference series include:

- ◆ presentations by a NASA astronaut, project scientist, or program administrator;
- ◆ updates on current NASA educational products, services, and programs;
- ◆ demonstrations of teaching activities and strategies;
- ◆ printed materials relevant to the topic;
- ◆ status reports on NASA projects and Space Shuttle launches; and
- ◆ opportunities to interact with the speakers.

The videoconference series is free to registered educational institutions. To participate, the institution must have a C-band satellite receiving system, teacher release time, and an optional long distance telephone line for interaction. Arrangements may also be made to receive the satellite signal through the local cable television system. The programs may be videotaped and copied for later use.

For more information, contact:

Videoconference Coordinator
NASA Teaching From Space Program
308A CITD
Oklahoma State University
Stillwater, OK 74078-0422
E-mail: julrich@quest.arc.nasa.gov

Educational Horizons

Educational Horizons is NASA's triannual publication for educators. Each issue announces opportunities for educators and students to interact with NASA and NASA's Field Centers through participation in in-service programs, acquisition of educational publications and multimedia products, as well as through cable television programming and teleconferencing. *Educational Horizons* is published in the fall, winter, and spring, and is available free by subscription to

educators. *Educational Horizons* is also available in electronic format through NASA Spacelink.

For more information, contact:

NASA Headquarters
Educational Horizons
Code FE
Washington, DC 20546-0001

NASA's Central Operation of Resources for Educators (CORE)

CORE is a worldwide distribution center for NASA's audiovisual educational materials. For a minimal fee, NASA CORE will provide educators with materials through its mail order service.

Educational materials available include videotape programs, slide sets, computer software, and laser discs. These materials are designed to increase awareness and understanding of NASA's scientific research and technology and provide an historical account of NASA's accomplishments. Through the use of these multimedia materials, teachers can provide students with the latest in aerospace information, which serves as a springboard for classroom discussion across the entire curriculum.

NASA CORE is a nonprofit organization jointly sponsored by NASA and the Lorain County Joint Vocational School in Oberlin, Ohio. An educator may request a catalog and order form by writing or calling:

NASA CORE
Lorain County JVS
15181 Route 58 South
Oberlin, OH 44074
Phone: (216) 774-1051, x 293 / 294
Fax: (216) 774-2144

◆ Resources

NASA Space Grant College and Fellowship Program

The NASA Space Grant College and Fellowship Program was established under public Law 100-147, The NASA Authorization Act of 1988, to ensure continued U.S. strength in space-related research and education and to capitalize on the multiple opportunities afforded by the space environment.

Space Grant objectives are to: (1) establish a national network of universities with interests and capabilities in aeronautics, space, and related fields; (2) encourage cooperative programs among universities, aerospace industry, and Federal, state, and local governments; (3) encourage interdisciplinary training, research, and public service programs related to aerospace; (4) recruit and train professionals, especially women, underrepresented minorities, and persons with disabilities for careers in aerospace science and technology; and (5) promote a strong science, mathematics, and technology education base from elementary through secondary levels.

Through the Space Grant Program, NASA has successfully forged a network of participating universities and other institutions in all 50 states, the District of Columbia, and Puerto Rico. The 52 Space Grant State Consortia currently consist of 355 institutions of higher education, 56 industry affiliates, 20 state/local government agencies, 28 nonprofit organizations, and 38 other education entities. Space Grant affiliates include many of the Nation's research-intensive universities, as well as private academic institutions, four-year institutions, and community colleges. Also included are 36 Historically Black Colleges and Universities (HBCUs), seven Hispanic-Serving Institutions (HSIs) and 11 Other Minority Institutions (OMUs).

For additional information on the National Space Grant College and Fellowship Program, please contact:

NASA Headquarters
National Space Grant College and Fellowship Program
Code FEH
Washington, DC 20546
Phone: (202) 358-1531

or for Internet access (World Wide Web) point to:

http://deimos.ucsd.edu/space_grant/NASASpacegrant.html

Experimental Program to Stimulate Competitive Research

The Experimental Program to Stimulate Competitive Research (EPSCoR) was established by the National Science Foundation (NSF) in 1979 in response to Congressional concerns about the concentration of Federal support for university research in a relatively small number of states. Congress began expanding EPSCoR beyond NSF to mission agencies in 1990 and in NASA's 1993 Authorization Bill required the Agency to begin implementing EPSCoR for the nineteen states designated by NSF as underfunded.

The program announcement, issued in June 1993 described an opportunity for eligible states to strengthen the academic research and infrastructure necessary to develop a long-term, self-sustaining, nationally-competitive research capability. Selected states were to receive a 3-year, \$500,000 annual award that required a matching commitment by the state. Nineteen of the twenty eligible states (NASA added the state of Connecticut) submitted proposals, which underwent a rigorous review process. Six proposals were clearly superior and their selection was announced in January 1994.

Selected states were Alabama, Arkansas, Kentucky, Louisiana, Montana, and the Commonwealth of Puerto Rico. They will award limited amounts of direct research funding and provide funds to enhance the existing infrastructure through purchasing equipment, supporting graduate students, providing opportunity for interdisciplinary research and/or cooperative activities, and funding faculty release time, technical support, or travel within their state.

In addition, NASA has awarded limited amounts of funding for individual research projects that showed promise in non-selected proposals. It is hoped that these clusters will serve as a nuclei for new proposals when the next competition is announced in Spring 1995.

Participation in the EPSCoR Program is limited to the following states, which have been identified as less competitive in receiving NASA Research and Development funding: Alabama, Arkansas, Connecticut, Idaho, Kentucky, Louisiana, Maine, Mississippi, Montana, Nebraska, Nevada, North Dakota, Oklahoma, South Carolina, South Dakota, Vermont, West Virginia, and the Commonwealth of Puerto Rico.

An EPSCoR home page on the World Wide is accessible at the following URL: <http://www.qrc.com/ehr/epscor/start.html>. For more information, contact:

Elaine Schwartz
Code FEH
NASA Headquarters
Washington, DC 20546

Internet Sources of MTPE Information and Data

- ◆ Mission To Planet Earth Home Page, 97
- ◆ Earth System Science Education (ESSE) Program WWW Server, 97
- ◆ Aspen Global Change Institute WWW Server, 97
- ◆ Earth Observation Images from Space Shuttle, 98
- ◆ The EOS Home Page, 99
- ◆ EOSDIS Distributed Active Archive Centers, 99
- ◆ NASA/JPL Imaging Radar, 101
- ◆ The NASA Home Page, 101
- ◆ NASA Spacelink, 101
- ◆ U.S. Global Change Research Information Office, 102
- ◆ Global Change Data and Imagery, 102
- ◆ Software, 104

The following section provides information on Internet sources of MTPE-related data and information. These sources vary widely with respect to the amount and type of information available. And, while every attempt was made to include the most up-to-date information, the Internet is a rapidly changing environment — references that existed at press time may no longer be available.

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Mission to Planet Earth Home Page

Office of Mission to Planet Earth

NASA Headquarters

World Wide Web--<http://www.hq.nasa.gov/office/mtpe>

An excellent starting point for learning about MTPE, the NASA Mission to Planet Earth Home Page provides a wealth of information on the following topics: Missions (MTPE satellites, instruments, and experiments); Science of the Earth System; Access to Data (links to data and imagery sources); What's News (press releases and other current information); Publications and Education Programs (descriptions of education programs and full text of many MTPE publications); and What is MTPE? Many links to other information resources are also included.

Earth System Science Education (ESSE) Program WWW Server

Universities Space Research Association

World Wide Web--<http://www.usra.edu/esse/ESSE.html>

The ESSE Program is a NASA-sponsored activity managed by the Universities Space Research Association (USRA). The program consists of participating universities that are developing undergraduate curriculum in Earth system science. These courses include survey-level courses for non-science majors and senior-level courses (see also page 52).

The ESSE WWW server includes materials developed by participating schools, as well as other Earth system science instructional materials, datasets, and related information. Current topic headings include:

- ♦ Information about the ESSE Program
- ♦ What's New in Earth Science Education (press releases, current events, etc.)
- ♦ Educational Resources (K-12, undergraduate and graduate education)
- ♦ Information by Type
- ♦ Information by Topic (physical climate system, biogeochemical cycles, external forcing)
- ♦ Information by Program
- ♦ Information by Agency

Aspen Global Change Institute WWW Server

Aspen Global Change Institute (AGCI)

World Wide Web--<http://infosphere.com/clients/smallworks/agci/>

AGCI's home page includes an overview of AGCI, information on their Summer Science Sessions (including abstracts and participants), education programs (including sample lessons from the Ground Truth Studies Handbook), and links

◆ Resource

to other science and education resources. An area under construction is the Global Change Research Summaries Database, which will be called *EarthPulse Notes* and is planned to have key-word search functions. *EarthPulse Notes* will also be accessible this summer through a pointer from NASA Spacelink and the U.S. Global Change Research Program (USGCRP) Global Change Research Information Office (GCRIO) server (see page 103). Through the database, AGCI also plans to provide access to videotapes of over 300 talks by leading global change researchers from around the world that have presented their work at AGCI's Summer Science Sessions.

Earth Observation Images from Space Shuttle

Imagery Services Branch Home Page

Johnson Space Center

Anonymous FTP--sseop.jsc.nasa.gov (User: photos; PW: photos)

Telnet--sseop.jsc.nasa.gov (Username: photos)

World Wide Web--<http://images.jsc.nasa.gov/html/home.htm>

Descriptions of over 250,000 astronaut photos are accessible on the Internet in the Space Shuttle Earth Observations Project (SSEOP) data base. The scale of this photography fills the gap between aerial photography and imagery from unmanned satellites. The database also includes descriptions of photos from the Skylab, Apollo, Gemini, and Mercury Programs, extending the length of record for some sites to more than 30 years.

The photographs can be viewed on laser videodisc (see page 76 for a more complete description of the laser videodiscs.) About 9,000 press release images (Mercury through STS-51), with journalistic captions, can also be viewed on the Imagery Services Branch Home Page, as can Earth observation photographs from the most recent missions, searchable by latitude or longitude. Plans call for all 250,000 of the astronaut photographs described in the growing SSEOP data base to be accessible in Mosaic.

Photographs of hurricanes, thunderstorms, squall lines, island cloud wakes, and the jet stream complement meteorological satellite images by offering better resolution and stereoscopic coverage of such phenomena. Earth limb pictures taken at sunrise and sunset document changes in the Earth's atmospheric layering. Critical environmental monitoring sites are photographed repeatedly over time; some have photographic records dating back to the early 1960s. Photographing at various Sun angles highlights different geologic features and takes advantage of sunglint to show intricate ocean structures and land/water interfaces.

The 20 descriptors in the data record for each photograph allow the user to search by latitude and longitude combined or by country and, with help, feature. (Help can be obtained from Dr. Mary Fae McKay at (713) 483-5143 and mmckay@snmail.jsc.nasa.gov or Mr. James Heydorn at (713) 333-6663 and

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heydorn@snmail.jsc.nasa.gov). A four-color brochure with representative photographs is also available from the Earth Science Branch, Mail Code SN5, Johnson Space Center, Houston, Texas 77058.

The EOS Home Page

Goddard Space Flight Center

World Wide Web--http://spso.gsfc.nasa.gov/spso_homepage.html

The Earth Observing System (EOS) Project Science Office at Goddard Space Flight Center maintains a World Wide Web server, which allows you to discover, retrieve, and display documents and data about the EOS and MTPE education from all over the Internet.

EOSDIS Distributed Active Archive Centers

The Earth Observing System Data and Information System (EOSDIS), a fundamental part of NASA's MTPE, will include data from EOS spacecraft, airborne and ground-based instruments, and existing data sets. The EOSDIS Distributed Active Archive Centers (DAACs), with nine locations throughout the United States, are responsible for distribution of all EOS-related data. A listing of EOSDIS DAACs is on page 100.

EOSDIS DAACs:

ASF DAAC

Disciplines: Sea Ice, Polar Processor Imagery, SAR
Alaska SAR Facility, GeoData Center
Geophysical Institute - GeoData Center
University of Alaska
Fairbanks, AK 99775-7320
Internet - uso@eosims.asf.alaska.edu
Phone - (907) 474-6166; *FAX* - (907) 474-5195
World Wide Web URL -
http://eosims.asf.alaska.edu:12355/datacenters_documents/ASF_datacenter_doc.html

CIESIN DAAC

Disciplines: Socio-economic Data
Consortium for International Earth Science
Information Network
Socio-Economic Data and Applications Center

2250 Pierce Road
University Center, MI 48710
Internet - ciesin.info@ciesin.org
Phone - (517) 797-2727; *FAX* - (517) 797-2622
World Wide Web URL - <http://www.ciesin.org>

EDC DAAC

Disciplines: Land Process Data
United States Geological Survey - EROS Data Center
Sioux Falls, SD 57198
Internet - eros@edcserver1.cr.usgs.gov
Phone - (605) 594-6116; *FAX* - (605) 594-6589
World Wide Web URL -
<http://sun1.cr.usgs.gov/landdaac/landdaac.html>

GSFC DAAC

Disciplines: Upper Atmosphere, Atmospheric Dynamics, Global Biosphere, Geophysics
NASA/Goddard Space Flight Center
Code 902.2
Greenbelt, MD 20771
Internet - daacuso@daac.gsfc.nasa.gov
Phone - (301) 286-3209; *FAX* - (301) 286-1775
World Wide Web URL:
http://daac.gsfc.nasa.gov/DAAC_DOCS/gdaac_home.html

JPL DAAC

Disciplines: Ocean Circulation and Air-Sea Interaction
Jet Propulsion Laboratory
MS 300-320
4800 Oak Grove Drive
Pasadena, CA 91109
Internet - podaac@podaac.jpl.nasa.gov
jpl@eos.nasa.gov
Phone - (818) 354-9890; *FAX* - (818) 393-2718
World Wide Web URL: <http://podaac-www.jpl.nasa.gov>

LaRC DAAC

Disciplines: Radiation Budget, Clouds, Aerosols, Tropospheric Chemistry
NASA/Langley Research Center
Mail Stop 157B
Hampton, VA 23681-0001
Internet - userserv@eosdis.larc.nasa.gov
Phone - (804) 864-8656; *FAX* - (804) 864-8807
World Wide Web URL:
<http://eosdis.larc.nasa.gov/>

MSFC DAAC

Disciplines: Hydrologic Cycle
NASA/Marshall Space Flight Center DAAC User Services Office
977 Explorer Boulevard
Huntsville, AL 35806
Internet - msfc@eos.nasa.gov
Phone - (205) 922-5932; *FAX* - (205) 922-5859
World Wide Web URL:
<http://wwwdaac.msfc.nasa.gov/>

NSIDC DAAC

Disciplines: Snow and Ice, Cryosphere and Climate
User Services
National Snow and Ice Data Center
WDC CIRES, Campus Box 449
University of Colorado
boulder, CO 80309-0449
Internet - nsidc@kryos.colorado.edu
Phone - (303) 492-6199; *FAX* - (303) 492-2468
World Wide Web URL:
<http://eosims.colorado.edu:1733>

OAK RIDGE DAAC

Disciplines: Biogeochemical Dynamics
Oak Ridge National Laboratory (ORNL)
Environmental Sciences Division
P. O. Box 2008, MS 6407
Oak Ridge, TN 37831-6407
Internet - ornldaac@ornl.gov
Phone - (615) 241-3952; *FAX* - (615) 574-4665
World Wide Web URL:
http://www_eosdis.ornl.gov/

NASA/JPL Imaging Radar

Jet Propulsion Laboratory

Anonymous ftp--[jplinfo.jpl.nasa.gov](ftp://jplinfo.jpl.nasa.gov) (137.78.104.2)

Direct dial--(818) 354-1333. Parameters 8-none-1

World Wide Web--<http://southport.jpl.nasa.gov/>

Sources for the latest images from the two Space Shuttle Missions that carried the Shuttle Radar Laboratory (SRL).

Imaging radars provide a unique way of looking at the Earth and other planetary bodies. An imaging radar works very much like a flash camera in that it provides its own light to illuminate an area of interest and take a snapshot picture, but at radio wavelengths. The chief advantages to using radar are its ability to 'see' at night and through thick cloud cover. There are several operational spaceborne and airborne imaging radars being used for remote sensing of the Earth's environment, with more to come in the future.

In addition to images and other information, the Imaging Radar Home Page contains a radar remote-sensing science and applications section where the SIR-C educational CD-ROM can be viewed on-line (see page 77). Users can also read student reports from the Space Shuttle Missions, view a picture gallery of images, and play videos and animations.

The NASA Home Page

NASA Goddard Space Flight Center

World Wide Web--http://hypatia.gsfc.nasa.gov/NASA_homepage.html

This server contains NASA news releases, links to all NASA Center home pages, and public affairs information. It also includes an access point for NASA World Wide Web information organized by subject.

NASA Spacelink

NASA Marshall Space Flight Center (MSFC)

Direct-dial modem line--(205) 895-0028 (Terminal emulation: VT-100 is required, Data format--8-None-1, Baud rate:
Up to 14.4K bps)

World Wide Web--<http://spacelink.msfc.nasa.gov>Anonymous FTP--[spacelink.msfc.nasa.gov](ftp://spacelink.msfc.nasa.gov)Gopher--[spacelink.msfc.nasa.gov](gopher://spacelink.msfc.nasa.gov)Telnet--[spacelink.msfc.nasa.gov](telnet://spacelink.msfc.nasa.gov)

TCP/IP address--192.149.89.61

NASA Spacelink is an electronic information system that contains a wealth of factual information on the U.S. Space Program, along with educational materials that can be used by teachers at all levels to supplement lessons in mathematics, science, technology, and other disciplines.

◆ Resources

A special feature of NASA Spacelink is the "Spacelink Teacher Resource Center"(STRC), a restricted application available only to teachers who obtain a Spacelink Educator Account. The STRC provides extended access to other NASA electronic resources, and promotes the exchange of ideas with NASA and other educators. NASA Spacelink contains extensive information on Mission to Planet Earth, and for teachers who obtain STRC accounts, the system provides links to all the NASA MTPE information servers described in this catalog. To obtain a Spacelink Educator Account, send your request on school letterhead to the Spacelink Administrator at the address provided below.

For more information, contact:

Spacelink Administrator
NASA Marshall Space Flight Center
Mail Code CL01
Huntsville, AL 35812-0001
Phone: (205) 544-6360
E-mail: comments@spacelink.msfc.nasa.gov

U.S. Global Change Research Information Office

World Wide Web -- <http://www.gcrio.org>

The U.S. Global Change Research Information Office (GCRIO), in support of the U.S. Global Change Research Program (USGCRP), is a resource service for access to information and data concerning the prevention, mitigation, and adaptation to the effects of global environmental change. The GCRIO Home Page contains several USGCRP documents, including a hypertext version of the FY 1995 "Our Changing Planet" and CONSEQUENCES, a quarterly global change newsletter. An Education and Funding Resources section features links to student activities, teacher and education resources, as well as funding opportunities.

Global Change Data and Imagery

The following listing is a subset of the resources identified in the Earth System Science Education (ESSE) Program Server (see page 97), and provides Internet addresses of FTP, Gopher, Telnet, and World Wide Web servers of interest to Earth system science educators. The amount and type of information or images available from these sources varies greatly.

Anonymous File Transfer Protocol (FTP)

[manono.gsfc.nasa.gov](ftp://manono.gsfc.nasa.gov)
[jwocky.gsfc.nasa.gov](ftp://jwocky.gsfc.nasa.gov)
[huntress.jpl.nasa.gov](ftp://huntress.jpl.nasa.gov)
[explorer.arc.nasa.gov](ftp://explorer.arc.nasa.gov)

Ocean color data
TOMS ozone data
Earth, space science data
GOES and GMS images

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diamond.ssec.wisc.edu	GOES Pathfinder browse images
hurricane.ncdc.noaa.gov	NOAA climate archives
aurelie.soest.hawaii.edu	Geostationary Meteorological Satellite (GMS) imagery (Japan)
spacelink.msfc.nasa.gov	NASA Spacelink

Gopher Servers

gcds_gopher.esdim.noaa.gov	Global Change Data server
gopher.gsfc.nasa.gov	GSFC information server
gopher.ngdc.noaa.gov	NOAA geophysical data
info.er.usgs.gov	USGS information server
wx.atmos.uiuc.edu	University of Illinois weather machine
groundhog.sprl.umich.edu	University of Michigan Blue-Skies
gopher.ssec.wisc.edu	University of Wisconsin - Madison Space Science and Engineering Center (current meteorological satellite imagery)
meteor.atms.purdue.edu	Purdue University Weather Processor
spacelink.msfc.nasa.gov	NASA Spacelink

Telnet Services

nssdca.gsfc.nasa.gov	login: nssdc NSSDC/Global Change Master Directory
glis.cr.usgs.gov	login: follow instructions EROS Data Center Geographic Land Information System
madlab.sprl.umich.edu 3000	University of Michigan Weather Server
spacelink.msfc.nasa.gov	NASA Spacelink

World Wide Web (WWW) Servers

AVHRR Pathfinder Home Page
<http://xtreme.gsfc.nasa.gov/>
 Environmental Protection Agency WWW Server
<http://www.epa.gov/>
 EOS Pathfinder Datasets
<http://pathfinder.arc.nasa.gov/>
 Global Change Data Center Home Page
<http://ame.gsfc.nasa.gov/gcdc/gcdc.html>
 University of Illinois - The Daily Planet (meteorological images)
<http://www.atmos.uiuc.edu/>
 JASON Project (see also description on page 17)
<http://seawifs.gsfc.nasa.gov/JASON.html>
 Live Access to Climate Data
<http://ferret.wrc.noaa.gov/ferret/main-menu.html>

◆ Resources

Michigan State University archived weather loops and images

<http://rs560.cl.msu.edu/weather/index.html>

NASA Spacelink

<http://spacelink.msfc.nasa.gov>

National Center for Atmospheric Research

<http://www.ucar.edu/>

The National Geophysical Data Center

<http://www.ngdc.noaa.gov/whatsnew.html>

Purdue University - The Weather Processor

<http://thunder.atms.purdue.edu>

The StarChild Project: Connecting NASA and K-12

<http://guinan.gsfc.nasa.gov/K12/StarChild.html>

Topex-Poseidon Project Home Page

<http://topex-www.jpl.nasa.gov/>

The US Geological Survey Home Page

<http://info.er.usgs.gov/>

University of Wisconsin, Space Science and Engineering Center

(meteorological images and movies)

<http://ssec.wisc.edu/>

Software

The following are sources of software, including many freeware and shareware programs, needed for viewing imagery and animations and browsing the WWW.

Graphics Programs and Image Viewers:

sumex-aim.stanford.edu

ftp.apple.com

mac.archive.umich.edu

wuarchive.wustl.edu

madlab.sprl.umich.edu

Macintosh software (Anonymous FTP)

Apple Computer archives (Anonymous FTP)

Software archive (Anonymous FTP)

Another software archive (Anonymous FTP)

University of Michigan Blue-Skies software (Anonymous FTP)

spacelink.msfc.nasa.gov

NASA Spacelink -- graphics software for Macintosh, MS-DOS, Windows, and others (Anonymous FTP, Gopher, Telnet, or

World Wide Web; direct dial: (205) 895-0028, 8-none-1)

WWW Browsers:

Mosaic (National Center for Supercomputing Applications)

Anonymous FTP site -- ftp.ncsa.uiuc.edu

WWW site -- <http://www.ncsa.uiuc.edu>

Netscape (Netscape Communications)

Anonymous FTP site -- ftp.netscape.com

WWW site -- <http://www.netscape.com/info/how-to-get-it.html>

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 Public Access to Earth and Space Science Data Via Television
 A Science Infrastructure for Access to Earth and Space Science Data Through the
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COVER

Image courtesy of Professor T. Sakata, Tokai University, Tokyo, Japan. This visualization was created using data from NASA satellites, as well as other international Earth observing satellite data. An important aspect of NASA's Mission to Planet Earth is international cooperation, which is essential to the study of our global environment.

Space-based images of Earth, such as the one shown on the cover, are available to teachers and students through a wide variety of NASA educational resources. These resources include printed materials; audio-visual tools; and electronic resources such as the Internet, laserdiscs, and CD-ROM. See pages 67-104 for a full listing of NASA Mission to Planet Earth educational resources.

This catalog is available electronically through the Mission to Planet Earth Home Page on the Internet (<http://www.hq.nasa.gov/office/mtpe>) or through NASA Spacelink. NASA Spacelink may be accessed by computer through direct-dial modem or the Internet:

Direct-dial:	(205) 895-0028; VT-100 terminal emulation is required; Data format: 8-None-1
World Wide Web:	http://spacelink.msfc.nasa.gov
Anonymous FTP:	spacelink.msfc.nasa.gov
Gopher:	spacelink.msfc.nasa.gov
Telnet:	spacelink.msfc.nasa.gov
TCP/IP address:	192.149.89.61

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